MONTHLY WEATHER REVIEW.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for November, 1904, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph, and mail, 167; West Indian Service, cable and mail, 4; River and Flood Service, regular 43, special river and rainfall, 190, special rainfall only, 56; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 3025; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries, also printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. R. C. Lydecker, Territorial Meteorologist, Honolulu, Hawaii; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander H. M. Hodges, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San José, Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; Rev. José Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the Meteorological Service of the Republic of Cuba.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is 157° 30′, or 10h 30m west of Greenwich. The Costa Rican standard meridian is that of San José, 5h 36m west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

During November barometric pressure was generally low over the western North Atlantic, a succession of low areas following each other very closely. On the 1st and 2d, 16th and 17th, and 28th and 29th, however, areas of high pressure extended from the Atlantic coast of the United States over Bermuda. Over the Azores, the pressure was generally high throughout the month, but relatively low from the 1st to the 3d, from the 11th to the 14th, and from the 25th to the 27th. The only well marked storm of the month in the vicinity of the Azores occurred on the 12th, when at Horta a barometer reading of 29.60 inches and a maximum wind velocity of 52 miles an hour from the south were recorded. Over southwestern Europe, pressure was low on the 9th, 18th, from the 23d to the 24th, and from the 27th to the 30th, and generally high the remainder of the month. Over the British Isles high pressure prevailed from the 12th to the 18th. Before the 12th and after the 18th pressure was generally low, as a succession of storm areas attended by fresh gales passed over Ireland and Scotland, affecting England in their passage to a greater or less degree. The storm that reached the coast of Scotland on the 19th can probably be identified with the one of marked intensity that was central over Nova Scotia on the 14th, and crossed the Atlantic in high latitudes. This storm caused high winds and heavy snows quite generally over the British Isles on the 21st and 22d, and finally moved eastward to the continent of Europe.

In the United States, the barometric disturbances, with one or two exceptions, showed no remarkable features. During the first decade of the month the pressure was rather low over the Caribbean Sea, and on the 9th a shallow depression, apparently central south of the Isle of Pines, caused rain in southern Florida. This disturbance moved slowly northward, gradually increasing in intensity, and causing rain over the Florida Peninsula. During the night of the 12–13th its center had moved from Jacksonville to Hatteras, and fallen in pressure from 29.60 inches to 29.08. Rain occurred generally over the Southern and Middle Atlantic States, and high winds were reported along the coast. At noon, November 13, the center was east of Norfolk, with pressure below 29.00 inches. At 8 p. m. of the 13th, the center was near New York, N. Y., with a barometer reading of 28.74 inches at that point. Heavy precipitation occurred in the Middle Atlantic States and New England, and in many places this precipitation was in the form of snow, even as far south as North Carolina. High winds and gales were reported from all coast stations from Jacksonville to Eastport, a wind of 78 miles per hour being registered at Block Island. At 8 a. m. of the 14th the center of disturbance was over Nova Scotia, with a pressure of 28.60 inches and heavy rain and snow had continued over New England. By the evening of the 14th, the storm had passed off to sea, pursuing an east-northeasterly course, and apparently reaching the coast of Scotland on the 19th, somewhat diminished in intensity.

During the passage of this storm up the Atlantic coast,

much damage was done to shipping, and several lives were lost. The Life-Saving station at New Inlet was swept away by the heavy seas, and four of the men stationed there were drowned. The schooner *Missouri* was wrecked off Washington, N. C., and four lives lost. The barkentine *Elmiranda* was wrecked off the Florida coast and her mate drowned, captain and crew being rescued. The schooner *Arcularious* was blown on the rocks of the Massachusetts coast near Tarpaulin Cove, and her crew of four men lost. Communication by telegraph and telephone was interrupted in New England and the Middle Atlantic States, wires and poles were blown down, and the coast towns suffered considerable other damage.

Storm warnings were issued well in advance of the storm as it moved up the coast, and hurricane warnings were issued for the New England coast where it attained its maximum intensity. Undoubtedly much property and many lives were saved by the attention paid to these warnings.

While several moderate disturbances crossed the Lake region during the month, there was only one of marked intensity. While the storm just referred to was moving up the Atlantic coast, another was crossing the lower Lakes, and the two eventually united in the vicinity of New York, N. Y., on the 13th. This Lake storm caused considerable damage to shipping and property along the Lake shore. The tug *Gregory* was overturned by the gale off Buffalo, on the 13th, and the captain was drowned. That the loss of life and property was not greater and more widespread is explained by the Buffalo Enquirer of November 14.

Fortunately the Weather Bureau had sent out a storm warning early in the day, and this kept many boats from venturing out on the storm-tossed waves.

A number of storms appeared off the north Pacific coast during the month, and the high winds and gales which accompanied them did considerable damage to shipping. Timely warning was given of their approach, however. The following is from the Oregonian of Portland, Oreg., under the date of November 19:

The accuracy of the forecasts of the Weather Bureau on last week's storms was remarkable, and shipmasters who heeded the storm warnings and remained snug in port saved money for the underwriters and much unpleasantness for themselves. Considering the violence of the gales which raged for the greater part of the week, the Weather Bureau was quite fortunate in maintaining communication with the North Head station. The service from that point is of great value to the shipping community, and Mr. Beals, who has been untiring in his efforts to make it as prompt and accurate as possible is to be congratulated on his success.

The October drought in the Gulf States was broken in the first days of the month by the rains attending an area of low pressure which moved along the Gulf coast, and eventually up the Atlantic. Generous rains attended this storm along the Atlantic coast, and heavy rains accompanied the storm of the 11–13th. In the interior of the country, the month was unusually dry except in the Lake region, where moderate rains attended the passage of several low areas.

Killing frost and freezing temperature occurred in northeastern Texas on the morning of the 11th, extending as far south as San Antonio on the 12th, and eastward over Arkansas and northern Louisiana and Mississippi on the 13th. Light frost occurred as far south as Jacksonville and Mobile on the morning of the 15th. Ample warnings had been issued for all places affected. No well marked cold wave occurred during the month, and temperatures were generally moderate throughout the country.

NEW ENGLAND FORECAST DISTRICT.

The weather during November was more pleasant than usual for this month, with a general and marked deficiency in the precipitation, and temperature much below the normal. The month was one of the coldest of its name, and the drought in some sections almost amounted to a water famine. The only storm of consequence occurred on the 13–14th, and it reached all sections of New England, causing heavy snow in northern and interior and moderate to heavy precipitation, mostly rain, in other portions of the district. The disturbance was also accompanied by high winds and gales, which attained hurricane force at some points on the coast. No great damage resulted at Boston and its immediate vicinity, but at most interior points the snow and sleet, with the high winds, caused great damage and loss to the electric light service, telegraph, telephone, and cars, breaking down poles and wrecking wires. The destruction in this direction was probably the greatest and most widespread since the memorable storm of November 26–27, 1898. There was some loss of life and considerable loss and damage to shipping along the coast. The Weather Bureau gave pronounced and timely warnings of the storm's approach, and the information was of incalculable benefit, and doubtless resulted in the saving of many lives and a number of vessels. The local papers, in commenting on the storm, remarked as follows:

Boston Globe:

The storm had been predicted by the weather forecaster, and many who would suffer most from being exposed to its fury accepted the prediction warning and clung to places where they were least exposed to the storm.

The Boston Transcript:

Ample warning was given by the Weather Bureau, Saturday, of the approach of the storm, at a time when the skies were clear and a northeaster little expected; and to the warning is doubtless due the comparatively few number of wrecks and disasters.

J. W. Smith, District Forecaster.

NORTH-CENTRAL FORECAST DISTRICT.

No very severe storms passed over the upper Lake region during the month, although warnings were ordered in advance of five storms of moderate intensity, on the 9th, 12th, 19th, 23d, 28th, and 29th. The warnings on the two last named dates were for one storm, southeast warnings being ordered on the 28th, which were changed to northwest on the 29th.

The weather continued comparatively dry throughout the entire district, very little rain or snow falling. The temperature was considerably above the normal for the month, and no marked cold waves at any time passed over the district.—*H. J. Cox, Professor and District Forecaster.*

WEST GULF FORECAST DISTRICT.

The first extensive freeze of the season in the west Gulf district made its appearance over the northwestern portion of the district on the 11th, and extended southward during the 12th and 13th, and caused freezing or frost to the coast line. The temperature fell to 28° over black lands in the northern part of the sugar region and damaged cane slightly in a few localities, but the low temperature was of short duration and was generally beneficial to the crop. Frost or freezing temperature warnings were issued daily for some portions of the district from the 10th to the 12th. This enabled planters to save seed cane in good condition and to protect tender vegetation. No injurious frosts or low temperatures occurred without warning. No general storm occurred along the coast during the month.—*I. M. Cline, District Forecaster.*

ROCKY MOUNTAIN FORECAST DISTRICT.

No special warnings were issued or needed. The month was exceptionally dry throughout the district; bright skies were a feature, and temperatures were generally above normal.—*F. H. Brandenburg, District Forecaster.*

NORTH PACIFIC FORECAST DISTRICT.

The stormy season in this district began shortly before the middle of the month and lasted until near its close, during which time a succession of November gales of unusual severity occurred. Timely warnings were issued in all cases, and the casualties to shipping were small and confined wholly to vessels that had left port several days before the storms began,

and thereby were caught in the open seas and unable to obtain shelter in a safe harbor.

The disturbances were attended by generous rains west of the Cascade Mountains, notwithstanding which fact most of the rivers in that section were but little affected and maintained lower stages than usual under such conditions. The storms, after making their appearance off the Washington coast, in nearly every instance moved northeasterly over British Columbia, and on this account the rainfall in the intermountain section of the North Pacific district, was much less than usual.

The temperatures were uniformly mild, and in the principal agricultural sections of western Oregon and western Washington, no killing frosts have yet occurred.—*E. A. Beals, District Forecaster.*

SOUTH PACIFIC FORECAST DISTRICT.

The month opened with a moderate disturbance over the north Pacific coast accompanied with high southeasterly wind and rain as far south as San Francisco. The disturbance moved eastward along the international boundary. A succession of disturbances passed northward during the month, most of them too far north to influence conditions south of San Francisco. The month, as a whole, showed a deficient rainfall in the southern and central portions of the State. In the vicinity of San Francisco less than half the normal amount of rain fell, and in California, south of the Tehachapi, no rain fell during the month. The absence of rain at this time materially affects crop conditions. A heavy "norther" was reported in the valleys of the southern portion of the State on November 11. A marked disturbance occurred on November 15 and thunderstorms were reported in the northern portions of the State. The month was singularly free from frosts.—*Alexander G. McAdie, Professor and District Forecaster.*

RIVERS AND FLOODS.

River conditions during November did not differ materially from those of the preceeding month. The Mississippi River and its tributaries showed but slight change; in the northern portion there was a slow and steady fall throughout the month; in the southern portion there was a slight rise during the first half and a slow fall during the last half of the month.

The rivers of the Atlantic slope were highest during the middle of the month and with the exception of the Cape Fear, Pedee, and Wateree rivers showed but slight changes.

On November 1, 1904, a new river gage was put in service at Riverton, Ala.; the zero of the new gage is 1.2 feet lower than that of the gage used previous to November 1.

The highest and lowest water, mean stage, and monthly range at 251 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*E. B. Garriott, Professor.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Divison.

The following summaries relating to the general weather and crop conditions during November are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3300 and 14,000, respectively:

Alabama.—Weather favorable for gathering late crops. Long drought broken early in month. Beneficial rains early and latter parts of last decade, but precipitation generally slightly deficient. Several light freezes. Comparatively little plowing done. Some wheat and oats up to good stands by close of month; small acreage in oats, considerably more to be sown during winter. Cotton practically all picked by 15th, yield slightly above average. Corn all housed, yield good. Minor crops fairly good.—*F. P. Chaffee.*

Arizona.—Dry weather prevailed generally during November. Temperature averaged slightly below normal. Frost did little damage in central and southern counties, but suspended all growth in northern counties. Planting was in progress, except in the northern section of the Territory, where the ground was too dry for plowing. Dry feed was plentiful on ranges; stock was in good condition for the approaching winter, and farming conditions were generally favorable.—*H. K. Holcomb.*

Arkansas.—Temperature was about normal, rainfall deficient. Month favorable for gathering outstanding crops, but too dry for fall plowing. Cotton picking and corn gathering carried on without interruption, and by close of month only small per cent remained in field. Less than usual acreage sown to fall grains, but where sown they did fairly well. Stock not doing well, owing to scarcity of water and to lack of good pasturage—*O. C. Burrows.*

California.—Weather conditions were about normal, except in southern California, where abnormally high temperatures occurred, accompanied by drying winds. The rainfall in the central and northern sections was abundant for the season, and much progress was made in plowing and seeding. The drought seriously retarded farming operations in the southern sections. Early sown wheat made good growth. The grain acreage promised to be larger than usual, except in the south. Orange picking and shipping commenced on the 1st.—*Alexander G. McAdie.*

Colorado.—The month was favorable for the securing of crops, but was too dry for fall plowing. Grass was reported good, except in the Arkansas Valley, the south-central counties, and on the Divide, where it was reported fair. Stock water was generally sufficient, and at the end of the month cattle, horses, and sheep were in good condition.—*F. H. Brandenburg.*

Florida.—The month averaged cooler and wetter than the normal. Farm work was advanced. The last of the cotton crop was picked and minor crops harvested. The shipment of citrus fruits continued active, a large portion of the crop having been marketed. The condition of vegetables was improved, except in small areas where precipitation was deficient. Frost formed over all districts except the southern, and freezing temperatures occurred over portions of the western and northern districts; no damage.—*A. J. Mitchell.*

Georgia.—Unusually favorable weather for farming operations prevailed. Harvesting practically completed; yields generally good. Cotton above average, quality exceptionally fine. Moisture sufficient for fall plowing; seeding progressing rapidly, seed germinating and growing nicely. Increased acreage sown to oats, rye, and wheat. Low temperatures with killing frost on 14th to 18th and 27th and 28th. Cane grinding and potato digging in progress.—*J. B. Marbury.*

Idaho.—This was the driest and warmest November on record. Late fall plowing was retarded by dry weather. Winter wheat was slow in starting in localities, but was generally thrifty. Fruit trees were in excellent condition. Range grass was short in some localities. Stock was in fair to good condition.—*Edward L. Wells.*

Illinois.—A drought extending through October prevailed at the end of the month. The weather conditions were unfavorable for grasses and fall-sown wheat, but quite favorable for husking and garnering corn. Wheat maintained a good condition, but needed rain. Pastures were short in most sections and entirely bare in some. The greater portion of the corn crop had been husked and cribbed. Apples were keeping well in the northern counties, but much complaint of rotting was made elsewhere.—*Wm. G. Burns.*

Indiana.—The absolute range of temperature was 48°. Wheat suffered from freezing more than it would have had the ground been moist. November, 1904, was the driest on record in Indiana. The average precipitation was 0.36 inch, and the greatest amount at any station was 1.00 inch. Wheat and fall sown grasses in the central and southern sections suffered from drought. Good progress was made in cribbing corn.—*W. T. Blythe.*

Iowa.—The month was unusually warm and was the driest November on record. Ideal conditions prevailed for husking corn, which was mostly harvested without damage from heating. Pastures were excellent, and much fall plowing was done. Fall wheat and rye suffered some harm from drought. The total yield of crops was very satisfactory. The output of corn was about 60,000,000 bushels above the average of fifteen years.—*John R. Sage.*

Kansas.—Wheat generally was in good condition and most of it growing. The early sown wheat was all good, but the late sown was being injured in some counties by drought. Corn had generally been cribbed, except in the northwestern counties, where it was being gathered. Stock continued in good condition, but in the southern counties stock water became scarce.—*T. B. Jennings.*

Kentucky.—The drought that prevailed during October continued throughout November. It was general over the State, except in a few

of the southeastern counties. The early wheat, which had come up, could make no growth and dried out until it showed little appearance of life; that sown late lay in the dust without germinating. The air was so dry that tobacco could not be handled, and at the end of the month very little had been moved.—*H. B. Hersey.*

Louisiana.—Very little rain in many parts of the State and drought became severe in many localities. Exceptionally favorable for gathering matured crops. Temperature fell to 28° November 13 over black lands in sugar region and damaged cane in a few localities, but the low temperature was of short duration and was generally beneficial to the crop by causing a more rapid development of sugar content. Grinding pushed forward rapidly, yield generally satisfactory. Fall gardens suffered from effects of dry weather. The orange crop was good. The acreage seeded to wheat, oats, rye, and barley was small.—*I. M. Cline.*

Maryland and Delaware.—The month was cold and dry, but unusually pleasant and favorable for work. The notable feature was the severe coast storm of the 13th, with attendant heavy snow and rain and damage to telegraph service. This storm gave most of the monthly precipitation. Corn was practically all secured, both grain and stover in fine condition. Wheat was short, but well rooted and free from fly. Much plowing was done. Water was very low in western counties.—*Oliver L. Fassig.*

Michigan.—The weather during November was warm, pleasant, and very dry. These conditions were very favorable for harvesting corn and sugar beets, but were detrimental to pastures and the best growth of winter wheat and rye. Winter wheat at the beginning of the month was in very good condition, but made little if any growth during November, yet at the close of the month did not show any material deterioration. Pasturage was quite poor. The soil at the close of the month was very dry.—*C. F. Schneider.*

Minnesota.—A month of unusually mild temperature, with sunny weather and little precipitation. All lakes unfrozen till late in the month. Rye generally good. Plowing early in the month. The dry weather was favorable for finishing thrashing and for corn husking. There was very little snow lying on the ground at any time in the southern half of the State—*T. S. Outram.*

Mississippi.—Unusually favorable weather prevailed for gathering crops. Cotton picking was interrupted by rain on only three or four days, and was practically completed by the close of the month, except in a few western counties, where labor was scarce. The crop was secured in fine condition, with a yield considerably above the average. Cane yielded well. But little fall plowing or seeding was done on account of the very dry fall.—*W. S. Belden.*

Missouri.—The month was the driest on record, covering a period of twenty-two years. The lack of moisture was somewhat detrimental to the wheat crop. The plant made much less than the normal growth above ground, but, as is usually the case during dry autumns, extra root growth was developed in the effort to find moisture in the subsoil. Damage by the Hessian fly, while not serious, was noted in nearly every county. About half of the corn crop was cribbed; that part of the crop remaining in the field was in shock and in good condition.—*George Reeder.*

Montana.—Warm, dry weather prevailed throughout the month. Fall work, except plowing, made favorable progress. The most unfavorable feature affecting cattle and sheep was the scarcity of water on the range. Range feed was still fairly plentiful in the eastern counties; much stock was being pastured on meadows. Fall wheat and rye were up in a few favored sections, but over most of the State these crops made little or no growth.—*R. F. Young.*

Nebraska.—The dry, warm weather of the month allowed rapid progress in corn husking and generally rather more than three-fourths of the crop was in the crib at the end of the month. The dry weather was somewhat unfavorable for winter wheat, but no serious injury resulted from lack of moisture. The Hessian fly appeared quite generally and did serious damage in many places.—*G. A. Loveland.*

Nevada.—The month was remarkably dry, with warm days and cold nights. The weather conditions were very favorable to stock interests and for farm work. Feed in pastures and on foot hills was unusually good and stock of all kinds was in excellent condition throughout the month.—*J. H. Smith.*

New England.—The weather during the month was generally cold and dry. The mean temperature for the entire district, 32.6°, was the lowest for November in the history of the New England section of the Climate and Crop Service. The water in reservoirs, streams, and wells was low in many sections and rain was much needed. The fair weather and abundant sunshine were very favorable to farming interests and to outdoor pursuits.—*J. W. Smith.*

New Jersey.—Although droughty conditions obtained, early sown wheat, rye, and grass were in excellent condition and had an unusually good top; the late sown wheat, especially in the southern section, was backward, owing to a great lack of moisture. Meadows and pastures were remarkably good. Young apple and plum trees were badly infested with San Jose scale, and all efforts to check seemed futile.—*Edward W. McGann.*

New Mexico.—The mild, dry weather of the month was favorable for harvesting, hay baling, and some seeding. The soil was well moistened and favorable for late plowing and seeding. The range was short in some northern counties, but was generally fair to good throughout the Territory. Stock was in good condition. Water was plentiful and the outlook for winter generally favorable.—*Charles E. Linney.*

New York.—The weather was generally favorable for crops and farm work. Considerable plowing was done. Wheat and rye were in good condition, but growth was checked by drought. Streams were low and many wells were drying up. Some damage resulted to timothy from freezing. Pastures were poor.—*Morgan R. Sanford.*

North Carolina.—The long drought was broken by copious rain on the 3d and 4th; general rains also occurred on the 12th and 13th. The soil was placed in good condition for plowing; seeding winter wheat and oats proceeded rapidly, but was not completed. The bulk of the winter cereals was seeded late, but large crops were being sown. Early sown wheat showed good growth. Heavy to killing frosts during the month did not injure crops materially.—*C. F. von Herrmann.*

North Dakota.—The month was much warmer than usual, with generally clear skies and quite a decided deficiency in precipitation. Thrashing was finished in all sections. As the ground was not frozen to any great extent, fall plowing was extensively carried on. The absence of snow on the ground enabled stock to feed upon the open ranges throughout the month.—*B. H. Bronson.*

Ohio.—At most stations it was the driest month on record. Most of the rain fell on the 10th and 13th. The temperature averaged slightly below normal. Wheat made but little or no growth. Much of it was not up in the south. Pastures and meadows were badly dried up as a result of the drought. Tobacco cured well, but was too dry for stripping. The husking of corn progressed fairly well.—*J. Warren Smith.*

Oklahoma and Indian Territories.—Wheat was in varying condition; early looked well over western portion, but was in poor condition elsewhere, while much of the late had not germinated or was a very poor stand; rain was badly needed to advance growth of crop. Cotton was nearly all picked, with fair to good yields secured in good condition.—*C. M. Strong.*

Oregon.—November was warmer than usual. The rainfall was slightly above normal in the northwest quarter of the State and deficient in all other sections. A large amount of land was plowed and seeded to fall wheat, vetch, and cheat, all of which germinated nicely. Pasturage was generally better than usual and stock nearly everywhere went into winter quarters in good condition. Fruit trees were in good condition to stand the coming winter.—*Edward A. Beals.*

Oregon.—[Report for October. Received too late for insertion in the October REVIEW.] The month throughout was very favorable for agriculture. The rains during the early part wet the soil to a good depth, and the long period of bright, sunshiny weather immediately following them afforded ample opportunity for outside work, and a large amount of plowing and seeding was accomplished. Early seeded wheat germinated nicely and its condition generally was above the average.—*Edward A. Beals.*

Pennsylvania.—The driest November in the history of the service (1887). Crops in practically all districts suffered from drought. At the close of the month early sown wheat ranged from fair to good; late sown had germinated and developed so slowly that much of it was in an unfavorable condition to withstand the effects of the winter weather. Meadows and pastures were turning brown. General farm work and plowing were well advanced. In many sections water was hauled for stock and domestic purposes.—*T. F. Townsend.*

Porto Rico.—There was a scarcity of precipitation in many sections up to the 24th, but after that date the rainfall was sufficient in all districts. The older canes were maturing well and sugar making had begun at many haciendas; the outlook for a good yield was excellent. Young canes were in good condition, although somewhat short. Cotton picking progressed during the month, and many new plots were planted. All crops were in good condition; pasturage was abundant and stock was doing well.—*E. C. Thompson.*

South Carolina.—The weather conditions during November were favorable for gathering the crops that remained in the fields, such as scattering late cotton, corn, sweet potatoes, seed peas, and minor crops. Enough rain fell to soften the ground and permit wheat and oat seeding, although this work was not finished. Germination was slow, though satisfactory. A general killing frost on the 15th brought to a close the growing season of 1904. There was no loss in harvesting from bad weather.—*J. W. Bauer.*

South Dakota.—Month considerably warmer and drier than usual. Conditions were very favorable for outstanding crops, for husking and cribbing corn, and for the uninterrupted grazing of stock on the open ranges. Live stock and winter range pasturage were in good condition, also winter rye and the limited acreage of winter wheat. Dry soil prevented the usual amount of plowing in some central counties. At the close of the month the cribbing of corn was nearing completion.—*S. W. Glenn.*

Tennessee.—The month generally was too dry and cool for the proper germination and growth of grain, but was exceedingly favorable for gathering matured crops, and at its close the finest corn crop for many years had been housed, and the gathering of cotton was about completed. Early sown grain was looking well and good stands were the rule. The acreage in wheat was considerably larger than that of last year.—*H. C. Bate.*

Texas.—Ideal weather prevailed during the month for harvesting operations, but the rainfall was not sufficient for seeding purposes and the

SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS, NOVEMBER, 1904.

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	51.8	— 1.4	Lucy	86	10	Anniston	21	15	2.98	—0.14	Scottsboro	5.74	Camp Hill	1.26
						Goodwater	21	28						
Arizona	53.6	— 0.4	Parker	94	8	Flagstaff, Tuba	8	12	0.02	—0.61	Bowie	0.40	40 stations	0.00
						Fort Defiance	8	11, 12						
Arkansas	51.4	+ 0.6	Amity	89	24	Heber	17	15	1.38	—2.44	Elon	4.90	3 stations	0.00
			Howe	89	4									
California	54.9	+ 1.5	Ventura	97	11	Bodie	— 1	19	1.44	—0.98	Monumental Mine	13.87	40 stations	0.00
Colorado	37.3	+ 2.6	Wray	77	27	Westcliffe	—11	10	0.04	—0.58	Santa Clara	0.63	29 stations	0.00
Florida	62.3	— 2.4	Malabar	86	3	Marianna	27	15	2.97	+0.72	Key West	6.22	Stephensville	1.50
						Molino	27	14						
Georgia	52.9	— 1.1	Blakely	85	4	Clayton	21	14, 15	3.07	+0.29	Fleming	4.66	Tallapoosa	0.68
Idaho	41.3	.....	Milner	73	1	Chesterfield	1	13	0.68	.....	Lake View	3.20	2 stations	0.00
Illinois	43.0	+ 2.6	Colchester	78	2	5 stations	11	27, 30	0.26	—2.30	Palestine	1.10	2 stations	0.00
			Friends Grove											
Indiana	41.9	+ 0.6	Seymour	82	1, 3	Rockville	10	27	0.36	—3.25	Bloomington	1.00	3 stations	T.
Iowa	41.0	+ 6.3	Ruthven, Waukee	80	18	Britt	4	30	0.15	—1.25	2 stations	0.50	Rockwell City	0.00
Kansas	46.2	+ 3.8	Coffeyville	84	7, 20	Norton	0	11	0.15	—1.01	Baker	0.60	Gove	0.00
Kentucky	44.7	— 1.2	Hopkinsville	79	2	Anchorage	14	27	0.89	—2.83	Middleboro	3.56	Catlettsburg	0.14
Louisiana	57.1	— 1.2	Lake Charles	85	1	Plain Dealing	20	13	2.00	—1.88	Collinston	6.20	Reserve	0.00
			Schriever	85	17									
Maryland and Delaware	41.8	— 2.5	Boettcherville, Md.	72	20	Oakland, Md	11	22	1.68	—1.30	Cambridge, Md	2.86	Westernport, Md	0.29
Michigan	37.7	+ 2.1	Marquette	73	3	Roscommon	— 6	28	0.45	—2.33	Houghton	2.06	2 stations	0.00
Minnesota	36.7	+ 7.8	Red Wing	78	3	Hallock	—14	30	0.14	—0.79	Mount Iron	0.60	Red Wing	0.00
Mississippi	53.4	— 1.2	Port Gibson	87	19	Austin	20	15	2.72	—0.51	Columbus	4.79	Tchula	1.02
Missouri	46.3	+ 3.6	Lexington	83	16	Sublett	11	30	0.22	—2.09	De Soto	0.89	8 stations	T.
Montana	39.7	+ 8.5	St. Pauls	80	4, 5	Culbertson	— 7	30	0.23	—0.65	Troy	3.86	6 stations	0.00
Nebraska	42.4	+ 6.3	Santee	81	18	Agate, Bridgeport	0	11	0.11	—0.48	Wisner	0.50	9 stations	0.00
Nevada	41.8	+ 2.3	Sodaville	80	7	Tecoma	2	11, 12, 19	0.06	—0.60	Lewis Ranch	0.68	18 stations	0.00
New England*	32.6	— 6.0	Rockport, Mass	67	20	Woodstock, Vt	—10	29	1.63	—2.55	Cummington, Mass	3.55	Derby Line, Vt	0.50
New Jersey	40.2	— 3.2	Bridgeton	69	3	Charlotteburg	6	29	2.18	—1.53	Englewood	3.40	South Orange	1.30
New Mexico	43.1	— 0.6	Carlsbad	86	21	Vermejo	— 6	11	0.20	—0.39	Carlsbad	0.96	11 stations	0.00
New York	34.2	— 2.9	Ripley	67	2	Arcade	—12	28	0.96	—2.19	Mount Hope	2.79	Plattsburg	T.
						Paul Smiths	—12	29						
North Carolina	47.7	— 2.0	Whiteville	79	21	Jefferson	12	15	3.36	+0.16	Pinehurst	5.72	Sloan	1.59
North Dakota	35.7	+12.4	Churchs Ferry	80	1	Dunseith	—10	30	0.09	—0.58	Jamestown	0.55	12 stations	T.
						Willow City								
Ohio	40.5	— 0.4	Napoleon, Warren	75	3	Medina	0	28	0.37	—2.61	Canton	1.22	Hedges	T.
Oklahoma and Indian Territories.	51.6	+ 2.5	Pauls Valley, Ind. T.	90	24	Woodward, Okla	8	12	0.21	—1.88	2 stations	0.80	5 stations	0.00
Oregon	46.9	+ 4.3	Williams	79	9	Silver Lake	8	29, 30	5.25	—0.45	Glenora	30.49	Ontario	T.
Pennsylvania	38.8	— 1.3	Skidmore	79	3	Coudersport	— 4	28	1.15	—2.09	Coatesville	3.22	Lock No. 4	0.14
Porto Rico	77.5	.....	Central Aguirre	98	2, 3	Adjuntas	55	30	7.74	.....	La Carmelita	16.17	Ponce	3.00
South Carolina	51.6	— 2.2	Walhalla	80	22	Greenville, Santuc	22	15	2.78	—0.05	Yorkville	4.39	Conway	1.20
South Dakota	39.4	+ 9.3	4 stations	80	5 dates	Cavite	—15	11	0.09	—0.45	Grand River School	0.38	2 stations	0.00
Tennessee	46.7	— 1.2	Dover	78	1	Jonesboro	11	15	2.46	—1.34	Walling	5.55	Dyersburg	0.59
Texas	57.0	+ 0.3	Athens	90	2	Texline	11	11	0.99	—1.46	Port Lavaca	4.91	5 stations	0.00
			Greenville	90	17									
Utah	39.4	+ 2.5	Fillmore	83	22	Woodruff	0	11	T.	—0.79	Meadowville	0.05	55 stations	0.00
Virginia	44.1	— 2.8	Bedford City	77	2	BurkesGarden	— 3	15	2.12	—0.43	Speers Ferry	4.05	McDowell	0.07
Washington	47.4	+ 4.6	South Bend	78	8	Crescent	19	12	5.37	+0.55	Brinnon	23.56	Pomery	T.
West Virginia	41.2	— 1.7	Bancroft	75	3	Lewisburg	9	15	0.64	—2.32	Elkhorn	3.05	Creston	0.07
			Moorefield	75	1	Green Sulphur Spgs								
Wisconsin	37.7	+ 7.7	Prairie du Chien	84	1	Prentice, Wausau	— 3	30	0.19	—1.42	Hancock	0.49	5 stations	T.
Wyoming	35.6	+ 5.9	Cambria	78	2	South Pass City	— 8	10	0.12	—0.51	Red Bank	0.95	6 stations	0.00

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

growth of young grain, especially in the northern counties. Killing frosts were general over the State on the 11th and 12th, except in the coast district, where light to heavy frosts occurred in exposed localities; damage from frost slight. Gathering of corn and cotton completed; harvesting of forage crops well advanced, yield good. Acreage in grain slightly increased where favorable conditions prevailed at sowing time, but in some of the central counties the acreage was below the average on account of drought. Early sown grain did well, but late sowings were backward. The cane crop, now practically harvested, gave highly satisfactory results both in quantity and quality of juice. Rice crop average, harvesting completed. Gardening generally a failure, except in the coast district. Pasturage good and stock in fine condition.—*William H. Alexander.*

Utah.—The close of November marked the sixth week of unprecedented drought throughout the entire section, leaving the atmosphere pervaded with dust and the soil thirsting for moisture. Early sown grain was nourished through the germination period by timely rains and warm weather, and has since made a stout resistance to the deteriorating influences of the drought. Later sown cereals have lain dormant in the dusty seed bed, with little hope of growing. A vast acreage was broken for spring planting, and farmers are, without exception, well prepared for the winter and spring seasons.—*R. J. Hyatt.*

Virginia.—The general weather conditions of the month were unfavorable for the progress of all fall sown crops, particularly in the great valley divison and portions of the middle division, where precipitation was relatively light. The deficiency in temperature was also injurious. Winter wheat and oats, rye, and clover made very slow advance, and, locally, some of the late seeding of these crops failed of germination. The work of the month consisted mainly of corn husking, late seeding, and putting farms in order for the winter.—*Edward A. Evans.*

Washington.—The month was unusually mild, with frequent and abundant rains in the western division, but a deficiency of precipitation in the eastern division. The rainfall in the eastern section was, however, sufficient to germinate winter wheat nicely and to cause it to grow well, except in very dry localities. Seeding was completed; a large acreage was put in. There was no snow in the wheat region, but the weather was not severe enough to injure wheat.—*G. N. Salisbury.*

West Virginia.—The rainfall was very light during the month. The drought was prolonged and serious and water very scarce. Wheat and rye made practically no growth, and the prospects were not encouraging. Stock was in fairly good condition, and was mostly being fed. Corn was mostly in crib, but some remained to be husked, as fodder was very dry to handle.—*E. C. Vose.*

Wisconsin.—The month was unusually mild and very dry. The precipitation at Milwaukee during the month was the least recorded in Novem-

ber in sixty-three years and at Manitowoc in forty-one years. Lack of moisture caused winter wheat and rye to make slow growth, but the plants were healthy and in good condition to withstand the winter.—*W. M. Wilson.*

Wyoming.—The weather for the month was unusually mild, and precipitation unusually light. Conditions were extremely favorable for stock interests, except that the absence of snowfall prevented many flocks from being pastured on winter ranges. The ranges of the State were in good condition and stock was keeping fat.—*W. S. Palmer.*

SPECIAL ARTICLES.

RECENT PAPERS BEARING ON METEOROLOGY.

Mr. H. H. KIMBALL, Librarian and Climatologist.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——.

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AIRY'S THEORY OF THE RAINBOW.

By Rev. D. HAMMER, S. J., Canisius College, Buffalo, N. Y.

[Reprinted from Journal of the Franklin Institute, November, 1903.]

Up to some seventy years ago Descartes's view of the formation of the rainbow was universally accepted. In 1836 the English astronomer Airy published a new theory, but, as it often happens, it found few admirers, some admitting it only for the explanation of the so-called supernumerary bows. Of late years, however, several scholars have endeavored again to draw the attention of scientists to Airy's theory; as prominent among them may be mentioned Messrs. Mascart and Pernter.

Why, then, one might ask, is Airy's theory so little known while that of Descartes is almost universally taught? The reason may be found in the difficult calculations requisite for a full understanding of Airy's theory. If, therefore, the latter can not, to a sufficient degree at least, be brought within the reach of nonexperts in physics and higher mathematics, no one will require of our colleges and text-books to pay much attention to it. But this is not the case. In his "Ein Versuch, der richtigen Theorie des Regenbogens Eingang in die Mittelschulen zu verschaffen," Doctor Pernter succeeded in putting it into such form that it may without difficulty be introduced into high schools and colleges.

In this essay we shall strive for the same end; our material is drawn from Doctor Pernter's writings on this subject.[1]

In order to show the differences between the two theories, we first give a short account of that of Descartes.

Fig. 1 represents the formation of the principal rainbow. A bundle of parallel rays strikes the raindrop. The one that passes through the center of the sphere is not deviated from its course, but all the others undergo a change in their former direction, corresponding to the respective angles of incidence. Following up one of them we see that after two refractions and one reflection it makes a certain angle with the line *MN*, the axis of the rainbow. This angle we call *O*. If now we take different angles of incidence increasing at a constant rate from 1° to 90°, we find by construction as well as by calculation that the angle *O* varies unequally, growing larger and larger till, at an angle of incidence of about 59° 24′, having reached its maximum, it again retrogrades to 0. Near this limit *O* has its smallest rate of variation; hence, much more light will be accumulated on this spot than at any other place of the illuminated field. It is this crowding together of (say) red rays that enables us to see the red of the rainbow. Now, since every color has its own index of refraction, every color has also its own maximum *O*. From this consideration it naturally follows that we must always see the well-known seven colors of the rainbow, and that, provided the apparent diameter of the sun be the same, the width of the bow and its colors remain unchanged. The reason is, the index of refraction, on which the calculation depends, is a constant quantity, and the size of the raindrop, the only variable, is disregarded entirely. Hence, the characteristic mark of Descartes's theory is constancy. It is simple in itself and easily understood, but facts prove its insufficiency.

To convince the reader of this assertion, we are to give an accurate description of the rainbow, a task which, though at

[1] "Ein Versuch, der richtigen Theorie des Regenbogens Eingang in die Mittelschulen zu verschaffen," "Neues über den Regenbogen" and "Die Farben des Regenbogens."

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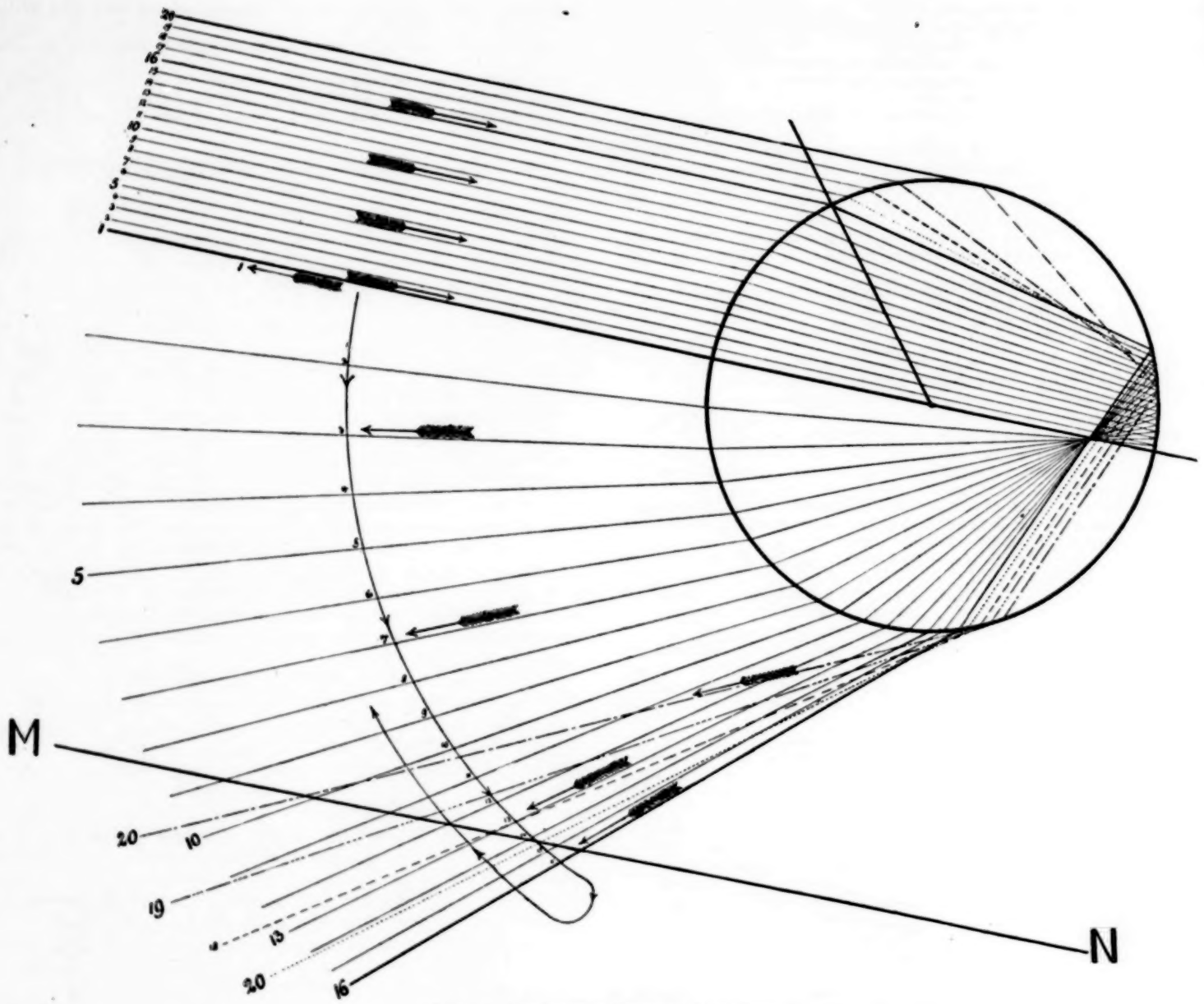

FIG. 1.—Illustrating Descartes's theory.

first sight may seem superfluous, is of real necessity, if we wish to correct several misconceptions. "Want of accuracy in observing the phenomenon," says Doctor Pernter, "contributed perhaps more than anything else to the fact that many were satisfied with an inadequate explanation, thus keeping up until the present day a properly false theory which otherwise would have been dropped."

Here we need not dwell upon such particulars as the axis of the rainbow, the concentricity of the arches, their division into principal and supernumerary bows (in the sequel we will designate the former as first, second, third, etc., rainbows; the so-called supernumerary bows we comprise under the name of "secondary" bows). All this supposed as known, we briefly enumerate those features which are sometimes overlooked, although just they furnish a strong proof that Descartes's theory is far from being complete enough to give a sufficient explanation of the phenomenon.

(1) In the principal rainbows the colors are neither always the same nor is their distribution constant. Most frequently no blue is seen, in other cases a really pure red is wanting; dark blue occurs rather as an exception. Now yellow almost disappears, whilst green and violet are prominent; again, yellow and green occupy the greater part, violet being reduced to a narrow extension. The intensity also changes; frequently the brightest spot lies in the beginning of violet. Finally, the variations in the width of both arch and its colors can not escape the eye of any attentive observer.

(2) The secondary bows are characteristic of the rainbows, so much so that they are by no means a rare occurrence and their absence is rather the exception. They often lie hard against the violet of the first rainbow and extend inward; under exceptionally favorable circumstances they border upon the violet of the second bow and extend outward. They, too, in accordance with the entire phenomenon, undergo several changes; their number varies from six to one, sometimes they are wanting altogether; mostly made up of green and rose, they now and then show yellow, green, and purple; or yellow, green, blue, and rose.

To the white rainbow we shall afterwards devote special attention on account of its importance for the new theory.

After this description of the rainbow, it is understood that that theory deserves our preference that accounts for all the numerous variations and explains the phenomenon in harmony with both light-theory and experiments. Airy's theory may

justly claim this prerogative. According to it the rainbow is essentially a phenomenon of diffraction; this statement, as we are going to show, derives its proofs from theory as well as experiments.

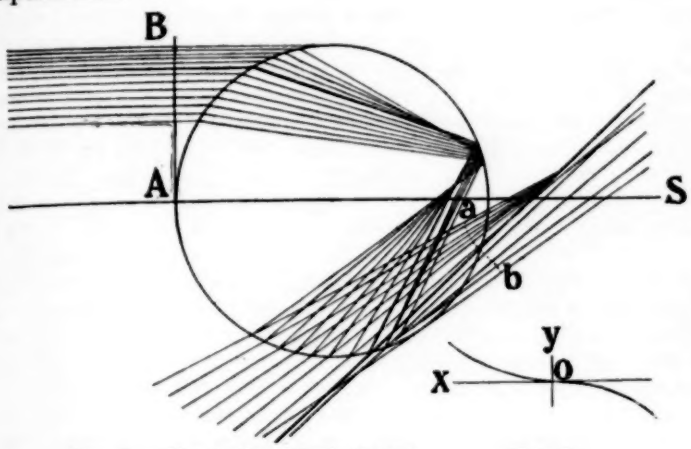

FIG. 2.—Illustrating Airy's theory. FIG. 2a.

Fig. 2 is constructed for rays whose index of refraction (n) equals $\frac{4}{3}$ (red-orange near the Frauenhofer's line C). As is seen, the rays which after refractions and reflection are prolonged backwards, form each a certain angle with AS, the ray that passes through the center of the sphere. This angle we call D. Its formula for all possible rainbows is:

$$D = k\pi + 2[i - (k+1)r],$$

k standing for the number of reflections, i for the angle of incidence, and r for that of refraction. Putting in p for $k+1$, we have

$$D = k\pi + 2\,(i - pr).$$

Examining the figure more closely we find that the heavy line occupies a peculiar position; for the angle it makes with AS is a minimum. This angle, which we may denote by Dm, is to be found by means of the formulas:

$$\sin I = \sqrt{\frac{p^2 - n^2}{p^2 - 1}} \text{ and } \cos I = \sqrt{\frac{n^2 - 1}{p^2 - 1}},$$

I standing for the angle of incidence corresponding to Dm.

In the subjoined table Dm is worked out for the five first rainbows:

	For water.				For glass.			
k.	I.		Dm.		k.	I.	Dm.	
	°	′	°	′		°	′	°	′
1.....	59	24	$\pi - 42$	4	1.....	49	48	$\pi - 22$	51
2.....	71	49	$\pi + 50$	56	2.....	66	43	$\pi + 86$	52
3.....	76	50	$2\pi - 42$	48	3.....	73	13	$2\pi + 9$	8
4.....	79	38	$2\pi + 43$	46	4.....	76	48	$3\pi - 71$	6
5.....	81	20	$3\pi - 51$	42	5.....	79	6	$3\pi + 27$	29

What then is the relation of the least-deviated ray to the formation of the rainbow? Fig. 2 shows it. All the rays, which come from a single point of the sun's surface and strike the drop, are practically parallel, owing to the great distance of the sun. Hence, the wave front can be designated by the line AB, perpendicular to one of them. But when the same rays leave the drop, their wave surface has necessarily become curved, as shown in the figure by ab. The curvature is such that the least-deviated ray forms its turning point. But somewhat divergent rays can not be united into one image in our eyes. Hence, in case the rainbow is perceived it can only be ascribed to rays that deviate least from parallelism. Such are those in the nearest vicinity of the least deviated ray. The very small portion of the wave, the rays of which are effective, is represented in fig. 2a, being, of course, highly magnified.

The mere shape of this wave front may tell us that we have to deal with the phenomenon of diffraction. This statement is based on Huyghen's principle, which says that the effect of a wave surface must be considered as the sum total of the effects of each point in the surface, whereby each point is taken as a wave former of its own, i. e., it sends out rays in all directions. In case of spherical wave fronts the final result is the same as if the wave had been produced only in the center of the sphere. But this is not true for other curved waves, particularly if there is a question of curvatures having a turning point. In this case diffraction must take place. If we use monochromatic light, an alternate series of light and dark bands will be observed; with white light these bands show a most beautiful variation of hues. Hence, the phenomenon is analogous to that observed through a diffraction grating. Still it offers a somewhat different character, since the producing wave surface is of a peculiar shape.

We now come to a point which Descartes's theory does not at all take into account, namely, the fact that the ever varying distribution of colors, and consequently the rainbow itself necessarily depend on the size of the drops.

The efficiency of the rays (fig. 2a) depends on the equation of the wave front. Calculation has established it to be

$$y = Hx^3,$$

wherein

$$H = \frac{h}{3a^2},$$

a standing for the radius of the drop and h for

$$\frac{(p^2-1)^2}{p^2\,(n^2-1)}\sqrt{\frac{p^2-n^2}{n^2-1}}.$$

From this equation it follows that such a wave surface necessarily gives rise to diffraction; moreover, since the radius of a drop enters as a factor into the equation, the further conclusion must be that with differently sized drops the phenomenon will show a different character. Given the equation and the radius of the drop we are enabled beforehand to construct the rainbow that will result. Professor Pernter undertook this weary task, and in an essay on the colors of the rainbow published the results obtained for drops whose radius respectively is 1000, 500, 250, 150, 100, 50, 40, 30, 25, 20, 15, 10, 5μ (μ = 1/1000 millimeter.)

The following four diagrams, fig. 3, we present to the reader, remarking that they are not the result of mere speculation, but that partly, at least, they were proved correct by actual experiments.

We must now prove that these theoretical conclusions have to do with the phenomenon of diffraction; the further conclusion is easily drawn that in case we use white light the different colors will overlap and thus give rise to mixed hues. Removing the glass and allowing the sunlight to fall upon the slit, a phenomenon is observed which is essentially the same as the rainbow seen in nature. For we observe a long series of bands: the first shows red on the one end followed by yellow, green, and violet (first bow), and the others (secondary bows) are a partial repetition of these hues.

We now proceed to the second part of the experiment. Instead of a cylinder measuring two to three millimeters in diameter, we use, say, one millimeter or a well-shaped glass thread. The contrast is striking. The bands are broader, the colors less saturated and partly of a different succession; the blue, which before could hardly be noticed, is now prominent. Hence, the phenomenon depends on the size of the cylinders. This conclusion, applied to the rainbow as it occurs in nature, gives a positive proof that the width of the entire bow, the width of the single colors, and their succession necessarily depend on the size of the raindrops. This we can understand better from figs. 4 and 5. They show how the intensities of the different colors are superposed. Fig. 5 es-

pecially gives us a fair idea of the final result, a white rainbow. (Cfr. No. I of fig. 3.) In the first set of intensities the maximum of all the colors occurs almost in the same spot; hence white is produced in the main part of the principal rainbow. Between the first and second set all the colors have their minimum intensity (=0) nearly at the same place, which explains the dark space between the principal and the first secondary bow as shown in No. I of fig. 3.

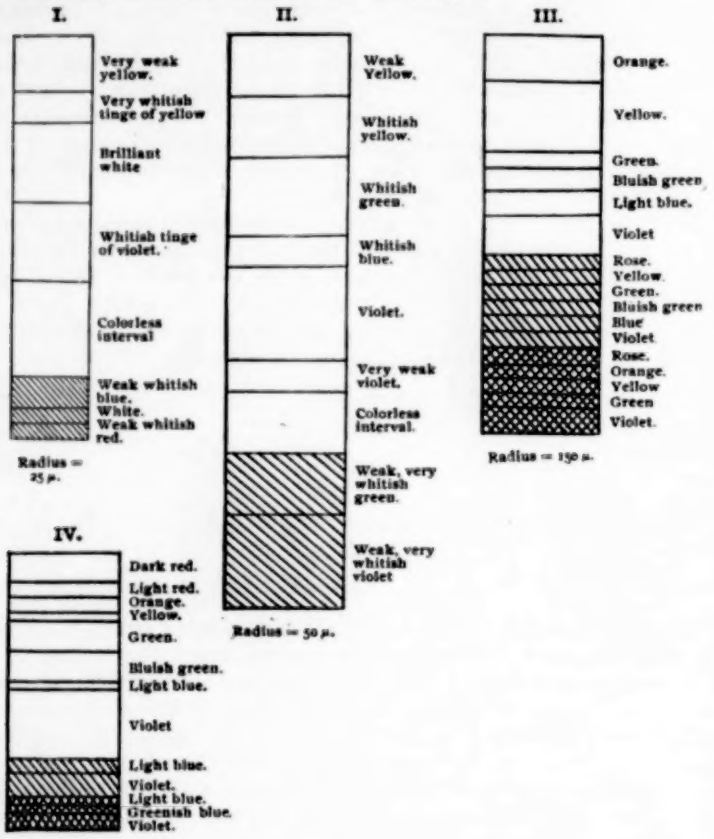

FIG. 3.—Four diagrams showing calculated rainbows. (Pernter.)

Calculations for $a = 500\,\mu$.		Experimental results for $a = 500\,\mu$.	
Angle.	x.	Angle.	Observed colors.
° ′		° ′	
42 10	Red		
42 0	Red		
41 50	Red		
40	Yellow	41 36	Maximum of intensity.
30	Green	41 35	Limit between yellow and green.
20	Green		
10	Green	41 7	Limit between blue and violet.
5	Blue	41 5	Beginning of the first violet.
41 0	Violet		
40 55	Violet		
50	Violet	40 50	End of the first violet.*
45	Blue	40 45	Beginning of the second violet.
40	Violet		
35	Violet		
30	Rose	40 30	Middle of the second violet.
25	Rose	40 25	End of the second violet.
20	Blue		
15	Bluish green		
10	Blue		
5	Rose	40 2	Middle of the third violet.
40 0	Rose	40 0	End of the third violet.
39 55	Blue		
50	Bluish green		
45	Blue		
40	Rose		
35	Rose	39 38	Middle of the fourth violet.
30	Blue		
25	Blue		
20	Violet		
15	Roes		

*Average of three values.

Thus far the experiment affords a general proof for the correctness of Airy's theory; its performance requires neither a skillful experimentalist nor a well furnished laboratory. However, a strictly scientific confirmation of the theory should be derived from experiments carried out with cylinders or drops of water, since it is water which in nature gives rise to the rainbow. W. H. Miller was the first to make experiments in this line; afterwards they were taken up especially by Mr. Mascart, who in 1888 published his extensive and exact researches in the Comptes Rendus. But since in the latter experiments only monochromatic light was made use of, Doctor Pernter saw himself necessitated to employ white light in order to have his calculations corroborated by experiment. Since their results demonstrate the accuracy of Airy's theory we think it proper to present them in their essential features.

A cylindrical water jet was passed through the center of the spectrometer, and illuminated by sunlight admitted through a very narrow slit of the collimator. The angles of the different colors were accurately measured. Of course it was a difficult task to produce a jet exactly equal to that assumed in the calculations; hence, Doctor Pernter sometimes had to content himself with an approximate value. There was also some difficulty in bringing the water column to the exact center of the apparatus; this might have caused an error of not more than $+4'$. Notwithstanding all these difficulties he succeeded in getting quite satisfactory data as regards the rainbows calculated for $a = 500\,\mu$ and $a = 250\,\mu$. We subjoin a table comparing the results of the calculations with those of the experiment. It is to be noted that in recording the colors seen in the experiment violet and rose were not distinguished; x stands for the color resulting from a mixture of hues.

With $a = 500\mu$, the colors succeeded each other as follows: pure red, orange, yellow, green, violet, blue, and the second violet; with $a = 250\mu$, red, orange, yellow, green, bluish green, blue, violet, rose. These data therefore afford the proof for Airy's assumption that the size of the raindrops plays an important part in the outcome of the phenomenon. As regards the secondary bows, another interesting observation was made. With $a = 500\mu$, twenty-four were numbered: the first eight consisted solely of violet (rose) and green or light blue; after the twelfth a band almost white, but shading somewhat into yellow, was seen, and the subsequent bows showed a trace of yellow before the violet; hence, the succession of hues was reversed. With $a = 250\mu$, eleven bows could be counted; the white band mixed with a tint of green occurred already in the fifth, and afterwards the hues followed each other again in reversed order. Comparing these results, we come to the conclusion that the number of visible bows decreases with the radius of the drops. The same was found true in the second rainbow; for with $a = 500\mu$, thirteen were observed; while with $a = 250\mu$, only five.

What we have said so far may suffice for the explanation of the rainbow as ordinarily observed and known to all. But perhaps we will not go amiss by considering more in particular also the white rainbow, a phenomenon of high importance for Airy's theory, because this explains it fully, while Descartes's view here leaves us in the dark.

A white rainbow may not infrequently be observed on mountains and on seashores, particularly in northern latitudes. If formed by sunlight, the principal bow is made up of a brilliant white, the margins are somewhat colored, the outer showing a yellowish and orange-red, the inner a bluish-violet tinge. The secondary bows, if any occur, are separated from the principal arch by a dark space, and their colors succeed one another in a reversed order, for a bluish seam lines the dark interval while the red lies toward the inside.

Since a white rainbow may be formed by sunlight as well as by moonlight, we are now to investigate the causes of the phenomenon. They may be reduced to three.

The first is the weak intensity of light in case of the lunar

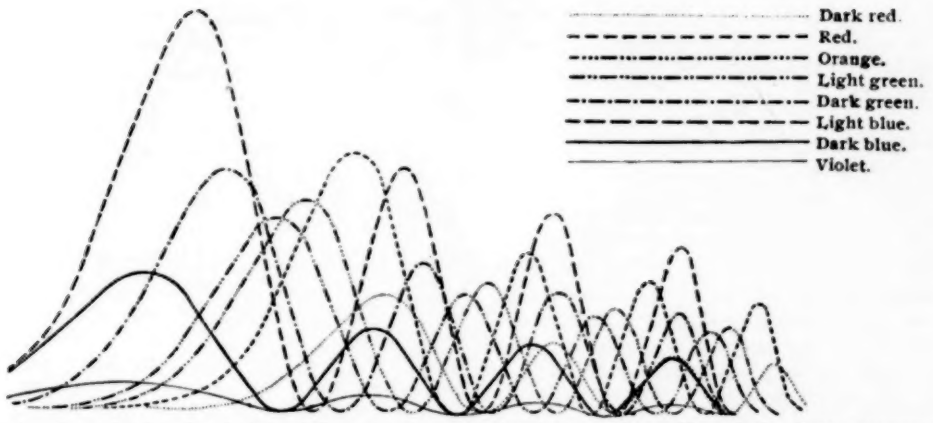

FIG. 4.—Showing how the bands of eight different colors overlap in case the radius of the drop measures 250μ. (Pernter.)

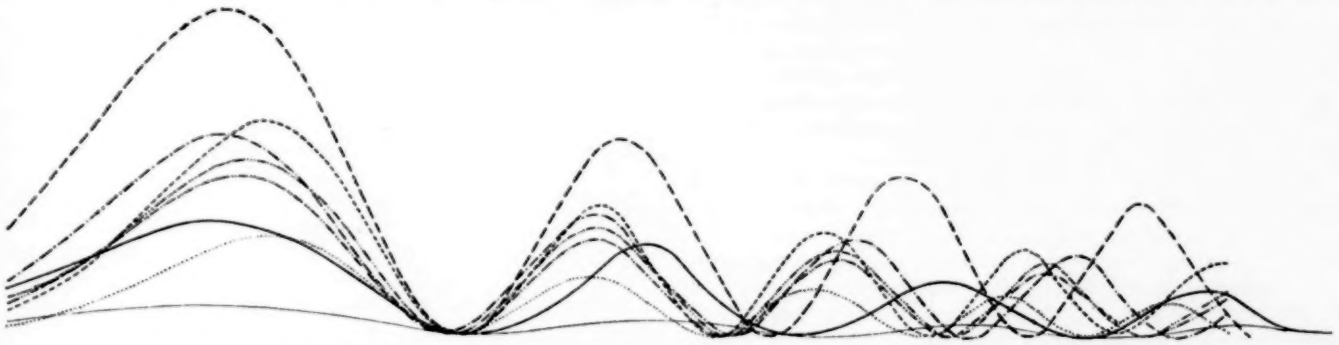

FIG. 5.—Showing how the bands of eight different colors overlap in case the radius of the drop measures 25μ. (Pernter.)

rainbow. Since it is a known fact,[2] that by lowering the intensity of a color beyond a certain limit, each color as such ceases to make its own impression and appears as a grayish white, we easily understand that on account of the weak intensity of moonlight the lunar rainbow shows a whitish appearance.

It would be very interesting to find out under what conditions of intensity the rainbow colors produce no effect on our visual organs. However, this question can not be answered with certainty. Messrs. Abney and Festing, it is true, have shown experimentally when color disappears from our sight, but these data can not be applied to the rainbow. First, there is no known standard to which we could refer the intensity of the rainbow colors. Moreover, since daylight, which is variable in brightness, mixes with the colors, the sensation itself will thus be differently affected. Finally, because the air as regards dryness and moisture, and the number of drops contained in a cubic meter (on which the intensity of colors depends) are variable, any estimate falls short of the reality.

A second cause is the inequality in size of the raindrops, whereby the different colors might be caused to overlap in such a way as to produce the sensation of white. Although we do not deny that this is possible, yet, since a white rainbow was never observed during a rainfall (it is assumed that it begins to rain when the drops have become at least 100μ in diameter) we need not dwell any longer on this explanation.

Very small drops are the third cause.

White occurs in every rainbow, whether in the principal or in a scondary one; however, we restrict the designation of "white rainbow" to those in which white is really prominent, without excluding differently colored shades.

Before we enter upon the explanation of this phenomenon, we must answer the question, in what case a mixture of colors gives rise to the sensation of white. Since every mixture of colors results into a pure spectral color and white, it is to be ascertained what percentage of each is required to make any color as such disappear. Mr. Abney proved that this percentage is the same for all colors, each disappearing in case a white light seventy-five times stronger be added. This means that white only then appears when the intensity of the color is 1.3 per cent of that of white. At first sight this law seems to import the impossibility of a truly white rainbow, since the calculated intensity of x is never as low as 1.3 per cent. The utmost we could expect is a sensible whitish shade in case x reaches 4 per cent. and below. Hence, in our explanation we have to show that x reaches the limit stated by Mr. Abney.

We must bear in mind that Mr. Abney made his experiments in a dark room, while the rainbow is formed in full daylight and sunshine; whence it follows that since the sunlight is white and intense in comparison with the colors of the rainbow, the percentage of x is lessened while that of white is increased. If, therefore, the intensity of x be near the limit, 1.3 per cent, and if daylight be added, we understand that a truly white rainbow can be the outcome.

A series of interesting experiments, carried out by Professor Pernter, confirms this explanation.

By means of ordinary atomizers he produced a fine water-spray (the size of the drops could not be measured on account of the small quantity of water), sunlight was allowed to fall upon it, and the phenomenon observed comported well with the raindrops figured out for very small drops. Red was wanting in the principal rainbow, and the orange showed a distinctly yellowish tint. Then very whitish shades of green and blue were seen, after which the violet came out more clearly as such. In full daylight these colors certainly would have given the rainbow represented in No. I of fig. 3; this conclusion is corroborated by the large extension of the principal rainbow.

In another experiment the water spray was dense enough to find the exact size of the drops. They measured 5.3 in radius. When sunlight fell upon the cloud of water dust a splendid white rainbow was obtained, owing, without doubt, to the

[2] Cfr. Abney and Festing, "Color Photometry," Part III, Philosoph. Transact., London, vol. 183 (1892), p. 537.

white sunlight, which, although admitted in small quantity, increased the percentage of white enough to reach the limit for x. With $a = 8.4\ \mu$ a white rainbow was yet obtained, the white band, however, had already decreased in width.

RADIATION IN THE SOLAR SYSTEM.

By Prof. J. H. POYNTING, F. R. S.

[Afternoon address delivered at the Cambridge meeting of the British Association for the Advancement of Sciences, August 23, 1904. Reprinted from Nature, September 22, 1904, vol. 70, p. 512.][1]

I propose to discuss this afternoon certain effects of the energy which is continuously pouring out from the sun on all sides with the speed of light—the energy which we call sunlight when we enjoy the brilliance of a cloudless sky, which we call heat when we bask in its warmth, the stream of radiation which supports all life on our globe and is the source of all our energy.

As we all know, this ceaseless stream of energy is a form of wave motion. If we pass a beam of sunlight, or its equivalent, the beam from an electric arc, through a prism, the disturbance is analyzed into a spectrum of colors, each color of a different wave length, the length of wave changing as we go down the spectrum from, say, 1/30,000 of an inch in the red to 1/80,000 of an inch in the blue or violet.

But this visible spectrum is merely the part of the stream of radiation which affects the eye. Beyond the violet are the still shorter waves, which affect a photographic plate or a fluorescent screen, and will pass through certain substances opaque to ordinary light. Here, for instance, is a filter, devised by Professor Wood, which stops visible rays, but allows the shorter invisible waves to pass and excite the fluorescence of a platinocyanide screen.

Again, beyond the red end are still longer waves, which are present in very considerable amount, and can be rendered evident by their heating effect. We can easily filter out the visible rays and still leave these long waves in the beam by passing it through a thin sheet of vulcanite. A piece of phosphorus placed at the focus of these invisible rays is at once fired, or a thermometer quickly rises in temperature. The waves which have been observed and studied up to the present time range over some nine octaves, from the long waves described to the section yesterday by Professor Rubens, waves of which there are only 400 in an inch, down to the short waves found by Schumann in the radiation given off by hydrogen under the influence of the electric discharge, waves of which there are a quarter of a million in an inch. No doubt the range will be extended.

Radiant energy consists of a mixture of any or all of these wave lengths, but the eye is only sensitive at the most to a little more than one octave in the nine or more.

This radiation is emitted not only by incandescent bodies such as the sun, the electric arc, or flames. All bodies are pouring out radiant energy, however hot or cold they may be. In this room we see things by the radiation which they reflect from the daylight. But besides this borrowed radiation, every surface in the room is sending out radiation of its own. Energy is pouring forth from walls, ceiling, floor, rushing about with the speed of light, striking against the opposite surfaces, and being reflected, scattered, and absorbed. And though this radiation does not affect our eyes, it is of the utmost importance in keeping us warm. Could it be stopped, we should soon be driven out by the intense cold, or remain to be frozen to death.

As the temperature of a body is raised, the stream of radiation it pours out increases in quantity. But it also changes in quality. Probably the surface always sends out waves of all lengths from the longest to the shortest, but at first when it is cold the long waves alone are appreciable. As it gets hotter, though all the waves become more intense, the shorter ones increase most in intensity, and ultimately they become so prominent that they affect our sense of sight, and then we say that the body is red or white hot.

The quality of the stream depends on the nature of the surface, some surfaces sending out more than others at the same temperature. But the stream is the greatest from a surface which is, when cold, quite black. Its blackness means that it entirely absorbs whatever radiation falls upon it, and such a surface, when heated, sends out radiation of every kind, and for a given temperature each kind of radiation is present to the full extent; that is, no surface sends out more of a given wave length than a black surface at a given temperature.

A very simple experiment shows that a black surface is a better radiator, or pours out more energy when hot, than a surface which does not absorb fully, but reflects much of the radiation which falls upon it. If a platinum foil with some black marks on it be heated to redness, the marks, black when cold, are much brighter than the surrounding metal when hot; they are, in fact, pouring out much more visible radiation than the metal.

It is with these black surfaces that I am concerned to-day. But, inasmuch as it seems absurd to call them black when they are white hot, I prefer to call them full radiators, since they radiate more fully than any others.

For a long time past experiments have been made to seek a law connecting the radiation or energy flow from a black or fully radiating surface with its temperature. But it was only 25 years ago that a law was suggested by Stefan which agrees at all satisfactorily with experiment. This law is that the stream of energy is proportional to the fourth power of the temperature, reckoned from the absolute zero, 273° below freezing point on the centigrade scale. This suggestion of Stefan served as the starting point of new and most fertile researches, both theoretical and practical, and we are glad to welcome to this meeting Professors Wien, Lummer, and Rubens, who have all done most brilliant work on the subject.

Among the researches on radiation recently carried out is one by Kurlbaum, in which he determined the actual amount of energy issuing from the black or fully radiating surface per second at 100° C., and, therefore, at any temperature.[2]

Here is a table which gives the amount at various temperatures, as determined by Kurlbaum:

Rate of flow of energy from one square centimeter of fully radiating or "black" surface.

Absolute temperature.	Calories (grams of water heated 1°) per second.
0°	0.0
100°. Air boils	0.000127
300°. Earth's surface	0.0103
1,000°. Red heat	1.27
3,000°. Arc carbon	103
6,000°	1,650
6,250°	1,930

As an illustration of the "fourth power law," let us see what value it will give us for the temperature of the sun, assuming that he is a full radiator, or that his surface, if cooled down, would be quite black.

We can measure approximately the stream of energy which the sun is pouring out by intercepting the beam falling on a

[1] The foot notes to this article, where not otherwise credited, are adapted from a technical paper by Professor Poynting: "Radiation in the solar system: its effect on temperature and its pressure on small bodies." Philosophical Transactions of the Royal Society, Series A, 1903, vol 202, p. 525.—*F. O. S.*

[2] [The constant factor, the product of which by the fourth power of the absolute temperature gives the amount of radiant energy per square centimeter per second, is called the constant of radiation. According to Kurlbaum, this constant, expressed in units of mechanical energy, is 5.32×10^{-5} ergs. By dividing this by the mechanical equivalent of heat, it becomes 1.27×10^{-12} calories or thermal units.]

surface exposed to full sunlight, measuring the heat given to that surface per second, and then calculating what fraction the beam is of the whole stream issuing from the sun.

This was first done by Pouillet, and his method will serve to illustrate the principal of all other methods.

In his apparatus the sunlight fell full on a box containing water, and the rate at which the water rose in temperature gave the energy in the stream of solar radiation falling on the box.

Simple as the experiment appears, the determination is beset with difficulties, the chief being the estimation of the fraction of the energy intercepted by the atmosphere, and we are still unable to give a very definite value. Indeed, we can not yet say whether the outflow of energy is constant or whether it varies. In all probability, however, it does vary, and Professor Langley, who has devoted years of work to the subject, has recently obtained evidence indicating quite considerable variation.

We may, however, assume that we are not very far from the true value if we say that the stream of radiation from the sun falling perpendicularly on one square centimeter outside the earth's atmosphere will heat one gram of water 1/24° C. every second, or will give 1/24 calory per second.[3]

Now the area of a sphere round the sun at the distance of the earth is 46,000 times the area of the sun's surface. The energy from 1 square centimeter of the sun thus passes through 46,000 square centimeters at the surface of the earth. It is, therefore, 46,000 × 1/24 calories, or 1920 cal./sec.[4] But from the table already given, a black surface at 6250° absolute, say, 6000° C., gives 1930 calories per second, or the temperature of the sun's radiating surface is 6000° if he is a full radiator, and there is good reason to suppose that no great error is made in taking him to be one.[5]

Let us now take another illustration of the fourth power law.

Imagine a little black body which is a good conductor of heat placed in full sunlight at the distance of the earth. Let it be 1 square centimeter in cross section, so that it is receiving 1/24 calory per second.

It will soon warm up to such a temperature that it gives out just as much as it receives, and, since it is so small, heat will rapidly flow through it from side to side, so that it will all be very nearly at the same temperature. A sphere 1 square centimeter in cross section has area 4 square centimeters, so that it must be giving out from each square centimeter of its surface 1/96 = 0.0104 calory each second. From the table above it will be seen that this corresponds very nearly indeed to a temperature of 300° absolute or 27° C., say 70° F.

It is to be noted that this only applies to a little round body. A flat plate facing the sun would be about 60° C. hotter, while if it were edgewise to the sun it might be very much colder.

Let us now see what would be the temperature of the small black sphere at other distances from the sun. It is easily seen that, inasmuch as the heat received, and therefore that given out, varies inversely as the square of the distance, the temperature, by the fourth power law, will vary inversely as the square root of the distance.[6]

Here is a table of temperatures of small black spheres due to solar radiation.

Distance from sun's center.	Temperature centigrade.
3¾ million miles	1,500°.....cast iron melts.
23 million miles	327°.....lead nearly melts.
At Mercury's distance	210°.....tin nearly melts.
At Venus's distance	85°.....alcohol boils freely.
At Earth's distance	27°.....warm summer day.
At Mars's distance	— 30°.....arctic cold.
At Neptune's distance	—219°.....nitrogen frozen.

We see from this table that the temperature at the earth's distance is remarkably near the average temperature of the earth's surface, which is usually estimated as about 16° C., or

[3] [Ångström estimated this value as 1/15 calory. Langley assumed that the atmosphere transmits about 59 per cent of the energy from a zenith sun, and from his measurement of the heat reaching the earth's surface he estimated the value of the constant at 1/20 calory per second. Rosetti assumed a transmission of 78 per cent from the zenith sun, but Wilson and Gray consider that 71 per cent represents Rosetti's numbers better than 78 per cent. If in Langley's value we replace 59 per cent by 71 per cent, we get 1/24 calory.] (Abbot, from observations at the Astrophysical Observatory of the Smithsonian Institution, obtains a value of about 1/27 calory per second.—*F. O. S.*)

[4] Or, more strictly, if A is half the area of the sun's surface, expressed in centimeters, then 1/24 A calories per square centimeter is the amount received at the earth from each square centimeter of the sun's surface, and $\frac{46000\,A}{24A}$, or 1920 calories, is the total radiation from each square centimeter of the sun.—*F. O. S.*

[5] [Accepting Ångström's value of the solar constant, we should find 7000° absolute as the sun's temperature, while taking Langley's value it would be 6500°. Wilson (Proceedings of the Royal Society, vol. 69, 1901–2, p. 312) made a direct comparison of the radiation from the sun with that from a full radiator at known temperature. Assuming that the atmosphere transmits 71 per cent of the radiant energy received from the sun when the sun is in the zenith, he obtained 5773° absolute as the solar temperature. If we denote the solar constant by S, and put

$$46000\,S = 1.27 \times 10^{-12} \times 5773^4$$

we get S equal to about 1/33 calory per second. This is no doubt too low a value. Either, then, Wilson's zenith transmission was less than 71 per cent, or Kurlbaum's constant is too small.

The low value is probably to be accounted for chiefly by the first supposition. Wilson points out that if x is the true value of the transmission, his value of the temperature is to be multiplied by $(71/x)^{\frac{1}{4}}$. If we take 6200° as the true value of the sun's temperature, then x will be found from the equation

$$x = \left(\frac{5773}{6200}\right)^4 \times 71 = 53.$$

This low value is not necessarily inconsistent with the much higher value, 71 per cent, used in finding Rosetti's solar constant, for no doubt the transmission varies widely with time and place, and we have no reason to assume that 1.77 calories per minute, obtained by Langley, would have been received from the zenith at the time and in the place where Wilson was making his determination.]

[6] [In determining the steady temperature of any body as conditioned by the radiation received from the sun, we have to consider whether it is necessary to take into account the radiation from the rest of the sky. If it receives S from the sun, ρ from the rest of the sky, and if its own radiation is R, then, in the steady state, that is, when the radiation that it gives out is equal to that received from all sources, $R = S + \rho$.

It behaves, therefore, as if it were receiving S from the sun, but as if it were placed in a fully radiating inclosure of such temperature that the radiation is ρ. This temperature is the "effective temperature of space."

The temperature may perhaps be more definitely described as that of a small full absorber placed at a distance from any planet and screened from the sun. Various well known attempts have been made to estimate this temperature, but the data are very uncertain. The fourth power law, however, shows that it is not very much above the absolute zero, if we can assume that the quality of starlight is not very different from that of sunlight.

According to l'Hermite (L'Astronomie, vol. 5, p. 406) starlight is one-tenth full moonlight. Full moonlight is variously estimated in terms of full sunlight. Langley (First memoir on the temperature of the surface of the moon, National Academy of Sciences, vol. 3) takes it as $\frac{1}{465000}$. These two values combined give sunlight as 4×10^6 starlight, but since starlight comes from the whole hemisphere, we must, for the purpose of comparing temperatures, consider the illumination that would be received if the whole hemisphere were paved with suns. This would be $46{,}000 \times 4 \times 10^6 = 1.84 \times 10^{11}$ times that from the stellar sky. If we assume that the ratio of the energy of the visible rays to the total energy is the same in both cases, then, according to the fourth power law, the effective temperature of space is equal to the temperature of the sun divided by

$$(1.84 \times 10^{11})^{\frac{1}{4}} = \frac{\text{temperature of sun}}{655}.$$

Since the temperature of the sun probably lies between 6000° and 7000° on the absolute scale, this gives the effective temperature of space as about 10° above the absolute zero.

If, then, a body is raised by the sun to even such a small multiple of 10° as, say, 60°, the fourth power law of radiation implies that it is giving out, and therefore receiving from the sun, more than a thousand times as much energy as it is receiving from the sky. The sky radiation may, therefore, be left out of account when we are dealing with approximate estimates and not with exact results.]

60° F. This can hardly be regarded as a mere coincidence. The surface of the earth receives, we know, an amount of heat from the inside almost infinitesimal compared with that which it receives from the sun, and on the sun, therefore, we depend for our temperature. The earth acquires such a temperature, in fact, that it radiates out what it receives from the sun. The earth is far too great for the distribution of heat by conduction to play any serious part in equalizing the temperature of different regions. But the rotation about its axis secures nearly uniform temperature in a given latitude, and the movements of the atmosphere tend to equalize temperatures in different latitudes. Hence, we should expect the earth to have, on the average, nearly the temperature of the small black body at the same distance, slightly less because it reflects some of the solar radiation, and we find that it is, in fact, some 10° less.[7]

Professor Wien was the first to point out that the temperature of the earth has nearly the value which we should expect from the fourth power law.

Here is a table showing the average temperatures of the surfaces of the first four planets on the supposition that they are earth-like in all their conditions.

Table of temperatures of earth-like planets.

	°C.
Mercury	106
Venus	79
Earth	17
Mars	—38

The most interesting case is that of Mars. He has, we know, a day nearly the same in length as ours; his axis is inclined to the ecliptic only a little more than ours, and he has some kind of atmosphere. It is exceedingly difficult to suppose, then, that his average temperature can differ much from —38° C. His atmosphere may be less protective, so that his day temperature may be higher; but then, to compensate, his night temperature will be lower. Even his highest equatorial temperature can not be much higher than the average. On certain suppositions I find that it is still 20° below the freezing point, and until some new conditions can be pointed out which enable him to establish far higher temperatures than the earth would have at the same distance it is hard to believe that he can have polar caps of frozen water melting to liquid in his summer and filling rivers or canals. Unless he is very different from the earth, his whole surface is below the freezing point.

Let us now turn from these temperature effects of radiation to another class of effects, those due to pressure.

More than 30 years ago Clerk Maxwell showed that on his electromagnetic theory of light, light and all radiation like light should press against any surface on which it falls. There should also be a pressure back against any surface from which radiation is reflected or from which it is issuing as a source, the value in every case being equal to the energy in a cubic centimeter of the stream. The existence of this pressure was fully demonstrated independently by Lebedew and by Nichols and Hull some years ago in brilliant experiments in which they allowed a beam of light to fall on a suspended disk in a vacuum. The disk was repelled, and they measured the repulsion and found it to be about that required by Maxwell's theory. Nichols and Hull have since repeated the experiment with greater exactness, and there is now no doubt that the pressure exists and that it has Maxwell's value.

The radiation, then, poured out by the sun is not only a stream of energy. It is also, as it were, a stream of pressure pressing out the heavenly bodies on which it falls. Since the stream thins out as it diverges, according to the inverse square of the distance, the pressure on a given surface falls off according to the same law. We know the energy in a cubic centimeter of sunlight at the distance of the earth, since, moving with the velocity of light, it will supply 1/24 calory per second. It is easy to calculate that it will press with a force of 6×10^{-5} dynes on a square centimeter, an amount so small that on the whole earth it is but 70,000 tons, a mere trifle compared with the three million billion tons with which the sun pulls the earth by his gravitation.

But now notice the remarkable effect of size on the relation between the radiation pressure and the gravitative pull. One is on the surface and proportional to the surface, while the other penetrates the surface and pulls every grain of matter throughout the whole volume.

Suppose we could divide the earth up in eight equal globes. Each would have half the diameter of the earth and a quarter the surface. The eight would expose twice the surface which the earth exposes, and the total radiation pressure would be doubled, while the total gravitative pull would be the same as before. Now divide up each of the eight into eight more equal globes. Again the radiation pressure would be doubled, while gravitation would be the same.

Continue the process, and it is evident that by successive division we should at last arrive at globes so small and with total surfaces so great that the pressure of the radiation would balance the pull of gravitation. Mere arithmetic shows that this balance would occur when the earth was divided up into little spheres 1/40,000 cm. in diameter.

In other words, a little speck 1/40,000 cm., say, 1/100,000 of an inch in diameter, and of density equal to that of the earth, would be neither attracted nor repelled by the sun.

This balance would hold at all distances, since both would vary in the same way with the distance. Our arithmetic comes to this: that if the earth were spread out in a thin spherical shell with radius about four times the distance of Neptune, the repulsion of sunlight falling on it would balance the inward pull by the sun, and it would have no tendency to contract.

With further division repulsion would exceed attraction, and the particles would be driven away. But I must here say that the law of repulsion does not hold down to such fine division. The repulsion is somewhat less than we have calculated owing to the diffraction of the light.

Some very suggestive speculations with regard to comets' tails have arisen from these considerations, and to these Professor Boys directed the attention of Section A last year. We may imagine that the nucleus of a comet consists of small meteorites. When these come near the sun they are heated and explosions occur, and fine dust is produced not previously present. If the dust is sufficiently fine, radiation may overpower gravitation and drive it away from the sun, and we may have a manifestation of this expelled dust in the tail of the comet.

I do not, however, want to dwell on this to-day, but to look at the subject in another way.

Let us again introduce our small black sphere, and let us make it 1 sq. cm. in cross section, 1.13 cm. in diameter, and of

[7] Mr. C. G. Abbot, of the Astrophysical Observatory, in a paper entitled "Radiation and terrestrial temperature," read before the Washington Philosophical Society on November 12, 1904, discussed the substantial equilibrium of temperature of the earth, and consequent equality of solar radiation absorbed in and about the earth to that emitted from and about the earth to space. After speaking of the great complexity of the earth and atmosphere as an absorber and radiator, certain maximum and minimum values of the solar constant and of the possible terrestrial temperature were obtained by considering the substitution of a black body or perfect radiator for the earth. In this way it was shown that the solar constant can not exceed 3.88 calories per minute, and may be indefinitely below this according as the earth reflects less than 44 per cent of solar radiation, or radiates to space less perfectly than a black body. Taking 1.9 calories as the minimum allowable assumption of the solar constant, it was shown that the mean temperature of the earth would remain above —33° C. if the earth were a perfect radiator and the reflection of solar rays did not exceed 44 per cent. Accordingly we owe not exceeding 58° C. rise of temperature to the imperfect radiation of the earth. (Science, December 9, 1904, vol. 20, p. 802.)

the density of the earth. The gravitation pull on it is 42,000 times the radiation pressure.

Now, let us see the effect of size on the radiating body. Let us halve the diameter of the sun. He would then have one-eighth the mass and one-quarter the surface. Or, while his pull was reduced to one-eighth, his radiation push would only be reduced to one-quarter. The pull would now be only 21,000 times the push. Halve the diameter again, and the pull would be only 10,500 times the push. Reduce the diameter to 1/42,000 of its original value, that is, to about 20 miles, and the pull would equal the push.

In other words, a sun as hot as ours and 20 miles in diameter would repel bodies less than 1 cm. in diameter, and could only hold in those which were larger.

But it is, of course, absurd to think of such a small sun as this having so high a temperature as 6000°. Let us then reduce the temperature to 1/20, say 300° absolute, or the temperature of the earth. Then the radiation would be reduced to the fourth power of 1/20, or 1/160,000, and the diameter would have to be reduced to 1/160,000 of 20 miles, or about 20 cm., say, 8 inches, when again radiation would balance gravitation.

It is not very difficult to show that if we had two equal spheres each of the density and temperature of the earth they would neither attract nor repel each other—their radiation pressure would balance the gravitation pull—when their diameters were about 6.8 cm., when in fact these were about the size of cricket balls.

It must be remembered that this is only true for spheres out in space receiving no appreciable radiation from the surrounding region.

It would appear that we have arrived at a result of some importance in considering the aggregation of small meteorites. Imagine a thinly scattered stream of small meteorites at the distance of the earth from the sun. Then, even if they be as large as cricket balls, they may have no tendency to move together. If they are smaller they may even tend to move apart and scatter.

In conclusion, let me mention one more effect of this radiation pressure. You will remember that radiation presses back against any surface from which it issues. If, then, a sphere at rest in space is radiating equally on all sides it is pressed equally on all sides, and the net result is a balance between the pressures. But suppose that it is moving. It is following up the energy which it pours forth in front, crowding it into a smaller space than if it were at rest, making it more dense. Hence, the pressure is slightly greater, and it can be shown that it is greater the greater the velocity and the higher the temperature. On the other hand, it is drawing away from the energy which it pours out behind, thinning it out, as it were, and the pressure at the back is slightly less than if the sphere were at rest.

The net result is a force opposing the motion, a force like viscous friction, always tending to reduce the speed.

Thus calculation shows that there is a retarding force on the earth as it moves along its orbit amounting in all to about 20 kgm., say, 50 lbs. Not very serious, for in billions of years it will only reduce the velocity by one in a million, and it will only have serious effects if the life of the earth is prolonged at its present temperature to hundreds of billions of years.

But here again size is everything. Reduce the diameter of the moving body, and the retarding effect increases in proportion to the reduction. If the earth were reduced to the size of a marble, the effect would be appreciable in a hundred thousand years. If it were reduced to a speck of dust a thousandth of a centimeter in diameter, the effect would be appreciable in a hundred years.

Note what the effect would be. Imagine a dust particle shot out from the earth and left behind to circulate on its own account round the sun. It would be heated by the sun and would be radiating out on all sides. As it journeyed forward there would be a resisting force tending to stop it. But instead of acting in this way the resistance would enable the sun to pull the particle inward, and the fall inward would actually increase the velocity. This increase in velocity would increase the resistance, and at the same time the approach to the sun would raise its temperature, increase the radiation, and so increase the resistance still further. The particle would therefore move in a more and more rapid spiral orbit, and ultimately it would fall into the sun. Small marble-sized meteorites would fall in from the distance of the earth probably in a few million years. Small particles of dust would be swept in in a few thousand years.

Thus, the sun is ever at work keeping the space round him free from dust. If the particles are very minute he drives them forth into outer space. If they are larger he draws them in. It is just possible that we have evidence of this drawing in in the zodiacal light, that vast dust-like ring which stretches from the sun outward far beyond the orbit of the earth, and is at once the largest and the most mysterious member of the solar system.

A SIMPLE, EFFECTIVE, AND INEXPENSIVE LIGHTNING RECORDER.

By HENRY F. ALCIATORE, Observer. Dated November 22, 1904.

In the latter part of August, 1902, the writer, at his own expense, constructed and erected in the local office of the United States Weather Bureau in New Orleans, La., a lightning recorder which has proved fairly satisfactory. Our object was to obtain automatic records of the hundreds of electric discharges, visible and invisible, that usually precede and accompany thunderstorms, and to study the same with a view to increasing the accuracy and value of local weather forecasts.

The action of the instrument is based upon the effect that high-tension electric waves in free air, such as lightning, have upon metal filings suitably arranged in a glass or other insulating tube between two metal electrodes, one of which is connected to a collector above the ground and the other to the earth. In their normal state the filings rest loosely at the bottom of the tube between two electrodes about 1/16 inch apart, and their electrical resistance is comparatively high. Now, when lightning occurs in the vicinity of the filings some of the electric waves traveling through the air pass through the filings from one electrode to the other; this causes the filings to stick together and their electrical resistance is greatly reduced, thereby rendering it possible for the current from a local battery to operate a relay in circuit with the filings, which in turn operates a device that separates the filings and restores them to their original condition, and at the same time records the passage of the electric waves.

Two years' experience with the lightning recorder described below has demonstrated that lightning records can be used to some advantage in making local forecasts. If, for instance, the recorder ticks frequently on a clear summer morning when there are no visible signs of an impending thunderstorm (each tick represents an electric discharge somewhere near the station, may be only a mile distant and may be 50 miles away) we conclude that the condition of the atmosphere is unstable, and that some time during the day there will be a thunderstorm. On July 3, 1903, for example, the first signal occurred at 5:21 a. m., and the first audible thunder at 12:40 p. m., or seven hours and nineteen minutes later. The last thunder occurred at 3:00 p. m., and the last signal at 3:53 p. m. About 180 signals were recorded by the instrument before the first audible thunder. In its present crude condition our recorder can not tell us from what direction the storm is approaching the station, nor with what speed and intensity, but by improving it such information may some day be obtained.

Among those most interested in forecasts of thunderstorms are the owners of extensive electric light and power plants, wherein thousands of dollars' worth of electric machinery are at the mercy of a stroke of lightning. While a lightning recorder can do nothing, directly, to prevent the coming of the destructive bolt, yet if a superintendent knew some hours in advance that a storm was coming he could prepare himself, and would have certain advantages over one taken unawares. This information the United States Weather Bureau may some day be able to give.

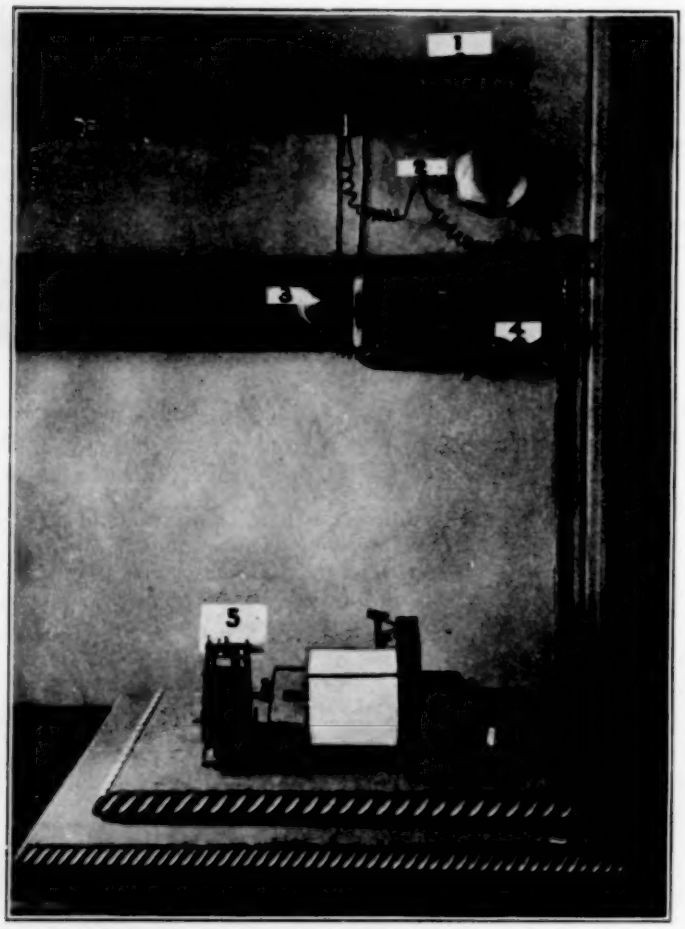

FIG. 1.—Lightning recorder. 1, decoherer; 2, coherer; 3, cut-out; 4, relay; 5, recorder.

For the benefit of those who desire to take up this interesting work the writer gives below a description, with approximate cost, of a simple, practical, and inexpensive lightning recorder, which can be made and installed by any one having an ordinary knowledge of electricity, and which will give warning of approaching thunderstorms anywhere from a few minutes to several hours in advance of the first peal of audible thunder. The instrument at New Orleans consists of—

THE COLLECTOR.

The collector is a hollow cylinder fourteen feet long and eleven inches in diameter, made of two sheets of commercial zinc nailed to three disks of wood, one at each end and the third in the middle. The edges of the zincs are soldered. There is an eye hook at the top of the guy lines and a ¼-inch bolt, about two inches long, at the bottom, which fits into an ordinary telegraph glass insulator, fixed to a six by six wooden board one inch thick nailed to the floor of the platform, upon which the collector stands in an upright position. The top of the collector is about 110 feet above the ground. Cost, about $3.00

THE COHERER.

The coherer consists of a piece of thick glass tube, one-quarter inch inside diameter, two inches long, into which are closely fitted two silver electrodes each one-quarter inch in diameter and three-eighths of an inch long, with a piece of copper wire soldered to each. The electrodes are about one-sixteenth of an inch apart. In the space between them are placed a few filings filed from a 10-cent piece of money with a coarse file. A dime piece will give enough filings for a dozen receivers. The spaces back of the electrodes are filled with plaster of Paris, to keep the moisture out. This coherer can be refilled at a cost of about two cents. Cost, about $1.00.

THE DECOHERER.

The decoherer is an ordinary 3½-inch doorbell, to the hammer of which is soldered a stout piece of wire, two inches long, at right angles with the axis of the hammer, and to which the coherer is attached by a piece of insulating tape. When the bell rings, the filings are shaken and separated. Cost, about $1.50.

THE RELAY.

The relay is of the ordinary kind used in telegraphy and has a resistance of about 150 ohms. Cost, about $5.00.

THE FUSE.

This is a piece of 2-ampere fuse, about three inches long, such as is used in electric light circuits. Cost, about five cents.

THE GROUND.

A sewer, gas, or water pipe, of metal, under the ground, or a small piece of metal buried in the earth will answer for a ground.

THE CUT-OUT AND DOUBLE CONNECTORS.

A small cut-out, with ebony handle, such as is used in electric light wiring, and two double connectors of the kind used in telegraphy are used. Cost, about fifty cents.

THE BATTERIES.

Two batteries are used, one of two dry cells for the coherer and one of four dry cells for the decoherer and recorder circuits. Cost, about $1.80.

THE WIRES.

A piece of No. 10 weather-proof, electric-light wire, to lead from the collector to the coherer, and a supply of office bell wire for office connections. Cost, about $1.00 for ordinary installations.

THE RECORDER.

The recorder consists of a strong clockworks; a hollow wooden cylinder, three and a quarter inches in diameter and three and a quarter inches long, mounted on an endless screw fixed to an upright iron support at one end; and a small doorbell magnet, on whose armature is soldered a self-inking pen made of a hollow brass cone about one-quarter of an inch in diameter at the base and one inch long. The cylinder carries a sheet of paper divided into hour and 5-minute spaces and makes a complete revolution once every hour. A fresh sheet is placed upon the cylinder every twenty-four hours. Every time the recorder ticks, the pen, which is suspended over the cylinder about one-sixteenth of an inch therefrom, strikes the paper and imprints thereon a dot. Cost, about $15.00.

ARRANGEMENT OF CIRCUITS.

The collector is on the roof of the building; the rest of the apparatus is in the office room.

Collector circuit.—Run a wire from the lower end of the collector to the fuse box; thence to double connector No. 1; thence to coherer; thence to double connector No. 2; thence to the ground.

Relay circuit.—Run a wire from double connector No. 1 to the cut-out; thence to relay post No. 1, also a wire from relay post No. 2 to battery No. 1; thence to double connector No. 2.

Decoherer and recorder circuit.—These instruments are in series. Run a wire from relay post No. 3 to the decoherer; thence to the recorder; thence to battery No. 2; thence to relay post No. 4.

The wire leading from the collector should be nailed to the lower end of the collector and soldered thereto. The wires leading to the coherer—about one foot on each side—should be flexible, so that they will not interfere with the movements of the decoherer. The decoherer should be tilted to one side—the side away from the hammer. As there is a small current passing through the coherer constantly, sooner or later it will "stick"—that is, refuse to work. Therefore it should be given a rest as often as possible by cutting it out or putting in one of the extras. Sometimes the decoherer bell will ring once and sometimes it will ring several times, according to the intensity of the lightning discharges. Closed-circuit batteries will last longer than open-circuit ones.

Dr. Lee DeForest, of the American DeForest Wireless Telegraph Company, during a recent visit to New Orleans, suggested to the writer the advisability of thoroughly insulating the coherer wires from the walls of the building.

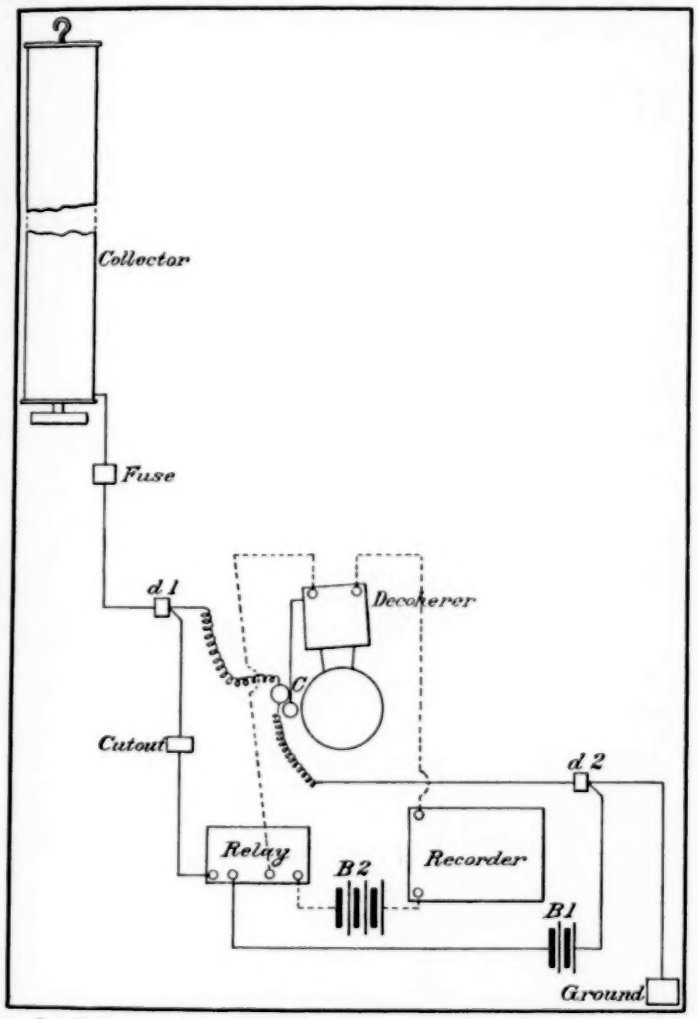

FIG. 2.—Diagram of the lightning recorder at New Orleans, La. *d*, double connector; *B*, battery; *C*, coherer.

Summarizing the results obtained so far it may be said that:

1. A practical lightning recorder can be made at small cost that will give results fully warranting the cost of construction.

2. Where written signals are not required, the bell on the decoherer can be utilized for giving audible signals; and the cost of the apparatus greatly reduced.

3. The recorder will not tick merely because the sky is cloudy and threatening; in cloudy weather it will give signals only when barometric and other atmospheric conditions favor the formation of thunderstorms. In storms coming from a great distance signals were recorded with a clear sky.

4. In most cases, frequent signals in the early forenoon indicate that a thunderstorm will occur later in the day. In some of the thunderstorms of which we have obtained records, the first peal of thunder heard at station was preceded by an hundred or more signals.

5. The collector described above is not an element of danger to the station. It will not attract lightning any more than an ordinary smokestack similarly exposed.

6. The cost of operating the lightning recorder need not exceed that of operating two large-sized doorbells.

7. Generally speaking, the higher the collector stands above the ground the larger will be its range of action.

In working out the mechanical details of the recorder the writer received valuable assistance from Mr. F. W. Ax, of the New Orleans office force.

THE INTRODUCTION OF METEOROLOGY INTO THE COURSES OF INSTRUCTION IN MATHEMATICS AND PHYSICS.

By PROF. CLEVELAND ABBE.

[Read November 26, 1904, at Chicago, before the Central Association of Science and Mathematics Teachers.]

The study of meteorology has acquired a new and vivid interest since the establishment of fairly successful weather forecasts in this country and Europe. The civilized world now knows that the weather and the climate, the winds and storms are controlled by rigorous laws of nature. We may not understand these laws as yet, but they are in control of the universe and we are to discover them and utilize them for the benefit of mankind. We have not yet found any limit to the attainments of the human intellect, and what the mind can do in the way of thinking the hand will find some means to attain in the way of doing. We must think out our work before we can do it.

The ultimate object of all your systems of education, elementary, collegiate, and postgraduate, is to train the mind to think and then train the hand to do. In old times the schools crammed the brain with the results of work already done, memorizing a multitude of facts; but now, while not neglecting the memory, we seek to develop the reasoning faculties, or the reasoning habit of thought, and then to perfect our methods of doing. Our schools pay much attention to mathematics, mechanics, chemistry, and science in general, because these have an important practical bearing on our lives. In this new progress, the professional side of education, meteorology has not been neglected altogether. I have been greatly pleased to see the enthusiastic reception accorded it in every part of the Union and its growing popularity in both graded and high schools. I suppose that we owe this specifically to the general success of the Weather Bureau, but more particularly to Prof. Wm. M. Davis, who established a school of meteorology about 1878 as a division of the school of geology at Harvard University. His students and text-books, his "Elementary Meteorology," the "Climatology" of his successor, Prof. R. DeC. Ward, and their methods of teaching have awakened teachers and professors alike to new possibilities. Other schools and other text-books have come into existence and the elements of the subject are now so well provided for that I do not need to say more about this; but I do feel the need of further advances.

I regard meteorology not so much as a matter of observation and generalization as a matter of deductive reason. Our studies have approached the limit of what we are likely to discover by inductive processes. We stand where astronomy stood in the days of La Place. We have had our Galileo and Newton, but we still need other leaders, and you will all agree with me that these must be trained in the schools. They must get their first lessons from you. Twenty or thiry years hence our future masters in meteorology will tell how their feet were turned in the right direction by the teachers of to-day.

In every school I find several boys and girls that have taken

a deep interest in the weather and its relations to our lives. They are often asking questions that bear upon it. They appear to observe and understand it better than others. These are they whom I would have you secure for the possible service of the Weather Bureau. There are others that often appear dull, but they are not really so; their previous education has perhaps been imperfect, some one has confused their minds with erroneous ideas, of which they can not easily rid themselves. There are others who have not yet awakened to a full interest in intellectual work. In general the school will be benefited by taking up exact and experimental work as compared with inexact, indefinite, texts or phrases. We benefit a child more than we realize when we give him exercises in exactness. Why do we make him calculate interest to the last cent? Why practise the piano or singing until he can do it properly? Why draw or paint correctly? Why speak English precisely? Is it not our conviction that what is worth doing at all is worth doing well. It is only the things that are well done that tell. Even in morals it is the bad thought that is the first step toward a bad act. So I wish to enforce the idea of teaching meteorology accurately and to do this we must use accurate expressions and experiments, accurate figures and drawings, and correct mathematics. On the other hand we enliven all mathematical and physical courses of instruction if we introduce into them applications to familiar subjects. The dullest student becomes alive as soon as he perceives that his distasteful mathematical tasks will help him to understand some subject that really interests him. There is no one, not even a child, that has not some favorite subject of thought, some one unanswered query, lurking in his brain. Find out what that is and you have found the keynote to which all his education may be made harmonious.

I know that the schools and colleges find so many subjects to teach and that the hours of work are so taken up at school and at home, that you will say, it is out of the question to introduce another new study. However, I do not venture such a presumption, but would suggest a simple and practical scheme. The idea is simple.

When you are teaching mathematics or physics and seeking for examples illustrative of the applications of these subjects, give especial attention to meteorology and take your examples from the phenomena of the atmosphere. You may not at first find many cases; certainly there are very few in the books. You may have to draw upon your own reading and knowledge or upon the notes that you will find in the MONTHLY WEATHER REVIEW. But with a little ingenuity you will soon accumulate a goodly number of problems that will afford your students abundant food for thought.

I find that many take up mathematical physics as one of the courses leading to the various engineering professions because the latter offer them a prospect of a good business for life; but occasionally one of these finds himself interested in the scientific or research aspect of the various problems as much as or even more than in the engineering aspect. He will probably combine research with his business, if, indeed, he does not altogether relinquish the latter for the former, provided a favorable opportunity offers. Such a man is representative of the class from which the ranks of the future army of American scientists will largely be recruited; and if you find any such, you will do well to help them develop their tastes for meteorology. They have studied mechanics, thermodynamics, steam engineering, electrical engineering, hydraulic engineering; they are graduates of our schools of engineering, they have truly the very best foundation for research in meteorology, and their tastes incline in that direction. One can not expect to make any great advance in meteorology without having a broad foundation, an inquiring mind, and great intellectual energy and perseverence. If the colleges and universities are not yet ready to give meteorology an independent place—a professorship, an observatory, a laboratory—as they do for astronomy, chemistry, geology, and many other branches of knowledge, then the best temporary arrangement that we can make is to introduce it freely among the problems illustrative of the general courses in the fundamental mathematical and physical studies of all exact science.

But you will ask for some definite examples.

(1) Among the simpler applications of trigonometry are the various efforts made to determine the altitude and motion of the clouds. The simplest method consists in determining the actual motion of a cloud by observing the perfectly parallel and similar movement of its shadow on the ground. One may stand upon an eminence and survey the landscape and with the help of a good map and the second hand of a watch or a simple seconds pendulum, may determine the direction of motion and the linear velocity of as many shadows as he wishes. If at the same time he looks directly upward and observes the apparent angular velocity of a cloud as it passes the zenith, he will find that he has now the base and one angle of a right-angled triangle, of which the other side is the cloud altitude, which of course can then be computed by trigonometrical tables or still better by geometrical constructions. Trigonometry, geometry, arithmetic, and algebra should all be kept at the finger tips ready for use by young students of science. Often times a young man will stand in front of a theodolite or some other complex apparatus and feel that it is too much for him; others have their heads full of mathematics, but do not know what to do with it. The expert is the man who not only has the knowledge but also the ability to do something with it. Our education should include especially the prompt and practical utilization of every scrap of knowledge that we have fortunately acquired.

(2) Another ingenious application of geometry to the altitude of clouds is known as Feussner's method. An observer stands at O and sees a shadow at K at a spot that he can identify on a detailed map of his surroundings. He recognizes that this shadow is that of a cloud at C that is located in the same vertical plane with the sun itself and he therefore observes the apparent angular altitude of that cloud, which is the angle $C\ O\ K$ in the triangle. Now the angle $C\ K\ O$ is the same as the apparent angular altitude of the sun, since a line drawn from O to the sun would be parallel to the line from K through C to the sun. If, therefore, the observer measures the angle by which the sun is above the horizon, or SOH, he will then know the base $O\ K$ and the two angles at O and K and may compute or construct the vertical height of C above the horizon. There are several refinements to be thought of. K may not be on the same level with O; the cloud may have moved before he can observe its altitude and the sun's altitude after having identified the shadow K as belonging to the cloud C. These refinements offer slight difficulties that may be overcome; thus if one has a correct watch he may simply observe the time when the shadow was at the point K, and from that compute at his leisure the altitude of the sun.

(3) One of the oldest methods of determining the altitude of a cloud is known as Bernoull's. The observer at O sees the cloud at C just as the last ray of the sun illuminates it. This last ray must have grazed the surface of the earth at some point W below the western horizon. By observing the time, we know at once the angle between the radii drawn to the earth's center from O and from W. This gives us the means of computing the distance from W to our vertical. But we also observe the apparent angular altitude of the cloud or the angle between $O\ C$ and the vertical. We have now all the data needed to solve the problem. We have in fact three triangles to solve in succession. The problem becomes more complicated if we endeavor to allow for the refraction of the ray of light from $W\ C$. I will not give the latter complex formula now, but may say that I hope to publish a long series

of these problems in a little handbook for the use of students and teachers, and I think that you will not find them too difficult for most of your students. In fact, text-books on trignometry while giving us many interesting problems suggested by the work of surveyors, navigators, and geodesists, seem to have quite forgotten that the clouds offer us still more fascinating problems.

(4) Some years ago the various weather bureaus of the world agreed upon a year of steady work on the altitudes of clouds. Some observers adopted the strictly trigonometric method of altitudes and azimuths. If a theodolite is placed at *A* and another one at *B*, the observers endeavor to sight simultaneously on a cloud at *C*. If they sight on the same point at the same time and observe the altitudes and azimuths correctly, then it would seem certain that with *A B* as the base line they should be able to compute the linear distance of the cloud *C* and its altitude. But unfortunately a cloud has considerable size and there is never an absolute certainty that *A* and *B* observe the same point. Accordingly there arises a very interesting problem as to what points they have observed. Oftentimes calculations showed that the two lines of sight did not and could not intersect, so that the shortest distance between the two lines would seem to be the proper place for the cloud. You will find all the details of this problem in chance, or the theory of errors, as it is called, in a report by Ekholm and Hagstrom.

(5) During that same year other observers used what is called the photogrammeter or the nephograph, which is simply a photographic camera mounted with altitude and azimuth circles. Photographs are taken of the same cloud simultaneously, and from them we may proceed by two methods, (1) we may measure from the photographic plate the angular bearings of various points in the clouds and determine the distance and dimensions of the whole cloud, or (2) we may proceed graphically, set the photographs up in a frame, reproducing as nearly as possible the original locations of the two cameras, and then, using threads as lines of sight, carve out in the air of the room a small model of the cloud itself. This latter process was, I believe, first carried out in England under the supervision of Prof. G. G. Stokes, the eminent mathematician, who was at that time a member of the Meteorological Council at London. In fact, that council has often included some of England's most famous men, and we are indebted to them for a number of important methods in meteorology.

(6) But perhaps the most fascinating as well as the simplest method of studying the clouds is by means of the nephoscope. This is a very simple instrument—merely a circular mirror held horizontally; you look into it and see the cloud by reflection, which saves the trouble of twisting the neck to an uncomfortable position. The mirror has a graduated circle corresponding to the azimuth circle; its center is marked by a dot or cross line and there are a few concentric circles drawn around that. At one side of the mirror is a light vertical rod holding a little knob, which may be raised or lowered and turned around to any azimuth, so that when one observes a cloud reflected at the center of the mirror he may so adjust the knob as to bring its image also at the center. But the cloud moves away and the observer must then move his eye so as to keep the knob covering the cloud until the knob and cloud disappear together at the edge of the mirror or cross some one of the concentric circles. In this process the knob is the center or intersection of two lines of sight, one from the cloud to the knob in its first position, and again from the cloud to the knob in its second position. The horizontal path described by the intersections of these lines with the face of the mirror is a miniature of the horizontal path described by the cloud in the time required by the images to pass from the center to the rim. We obtain thus the direction of motion of the cloud and a horizontal line that may be converted into the angular zenithal velocity. The prettiest application of this instrument and perhaps the most elegant of all methods of determining the height and velocity of the cloud I have called the kinematic method. The idea is this: If we are in a boat or on a train, our motion is combined with the motion of the cloud. We seem to attribute our motion to the cloud, and the observed line is a resultant movement that you easily obtain by compounding movements or forces by the method of parallelogram of forces. If we move from *A* to *B* in the boat with our nephoscope, it is as though the clouds move from *B'* to *A'* in the parallel but opposite direction; but if the cloud is actually moving from *B'* toward *X*, then the result that we observe is the line *B' X'* as seen from the boat. This apparent regular motion we are to observe first when the boat is going from *A* to *B*, and again when the boat is going in some other direction, such as *B* to *C*, or even when the boat is stationary, or when the boat directly reverses its movement, which we can most easily accomplish by carrying our nephoscope on a trolley or in a rowboat on a canal. Now, these two observations, together with the known velocities of the boat, give us four known terms in a pair of trigonometric equations, from which, by elimination, we determine the altitude and the actual velocity of the cloud. The most difficult point is to determine the velocity of the boat, and the method is, therefore, best adapted to give accurate results when the nephoscope is being carried by a steady steamer or by a car that is pulled by a cable, going at a perfectly uniform rate of speed in different directions, as, for instance, through the streets of a city.

(7) As another mathematical example, I happen to think just now of the so-called Poisson's equation relating to the behavior of pure dry air when undergoing adiabatic changes. This is given in some works on analytical mechanics and is mentioned in the elementary works on physics. But the good student will appreciate it better if you will give him the demonstration based on fundamental principles, which may be made almost purely mathematical.

When the same ideas are applied to the expansion and contraction of moist air, with its changes from vapor into cloud and snow, we come upon a more complex problem in physics; but even this is so largely a question of pure mathematics that it may be included under that category, and I hope that you will make your scholars familiar with the elegant graphic methods introduced by Hertz, whose paper is fully translated in my "Meteorology of the Earth's Atmosphere," and has been still more beautifully treated by Neuhoff in a German paper of 1901, but not yet translated. Elaborate mathematical tables are given by Professor Bigelow in his "Report on International Cloud Observations."

(8) The elementary text-books on physics often mention the theory of the wet-bulb thermometer and its use in determining the moisture of the atmosphere, but they rarely give any satisfactory explanation of the process by which physicists have deduced the relation between the temperature of the wet bulb and the moisture in the air—that is to say, the rate of evaporation; but the process is not so difficult but that anyone who has studied a little of the law of diffusion can understand it, and, for brevity's sake, I must refer you again to my Meteorological Apparatus and Methods.

[To be continued.]

NOTES AND EXTRACTS.

WORK OF THE WEATHER BUREAU.

The following items in relation to some features of the work of the United States Weather Bureau during the fiscal year ending June 30, 1904, are reprinted from the recently published report of the Secretary of Agriculture:

OBSERVATORY BUILDINGS.

Carrying out the policy of the Department, the Weather Bureau has continued to cooperate with the leading universities throughout the country, and at the present time the relations existing are more intimate and the work done more important than at any time in the history of the service. Several universities and colleges have donated ground for the erection of buildings. Appreciation of the value of the work being done by the Weather Bureau has also been demonstrated by several universities in placing at the disposal of the Bureau, without cost, office quarters in their buildings for recently established stations. The erection of buildings by the Weather Bureau saves the amount previously paid for rent of office quarters.

FORECASTS.

Weather forecasts for 36 and 48 hours in advance have been made daily throughout the year for each State and Territory, and special warnings of gales on the seacoasts, Gulf, and Great Lakes, and of cold waves, frost, heavy snows, floods, etc., have been issued when the advices would benefit commercial, agricultural, and business interests. The North Atlantic and West Indian storm-warning service was continued, and forecasts for the first three days out of steamers bound for European ports were issued daily at 8 a. m. and 8 p. m. In a number of instances European shipping interests were notified of the character and probable course of severe storms that were passing eastward from the American coast. Daily warnings and advices issued in connection with the injurious weather conditions of the year resulted in saving much property.

RIVER AND FLOOD SERVICE.

The floods of the year did not approach in character and importance the overflows of the spring of the year immediately preceding, when over 100 human lives were lost, besides property valued at over $40,000,000. There were, nevertheless, severe floods at various times, and in the management of the work occasioned by them the river and flood service continued to demonstrate its usefulness and growing efficiency as a valuable branch of the Weather Bureau. That there has been constant progress in the accuracy of its work is evidenced by the more specific and detailed character of the forecasts and warnings in localities where such exact work had heretofore been considered practically impossible. The service performed during the prevalence of the great winter ice gorges in the Susquehanna, Allegheny, and Ohio rivers, with their attendant floods, was especially noteworthy. These gorges were the greatest in the history of the localities, and that their great dangers were minimized is due in no small degree to the timely advices and warnings of the Weather Bureau.

There were minor floods during nearly every month of the year, but each was amply covered by timely warnings. These floods were not in any sense alarming or dangerous, but they nevertheless attained sufficient importance to endanger a large amount of property.

CLIMATE AND CROP SERVICE.

The National weather and crop monthly and weekly bulletins and the annual summaries and monthly and weekly bulletins issued from the 43 section centers, also snow and ice bulletins, daily bulletins issued in connection with the corn, wheat, cotton, sugar, rice, and fruit services during the growing season, and the special snow bulletins issued during the winter by the sections in the Rocky Mountain and Plateau regions have appeared regularly during the year, and have been of great value in affording timely information.

DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

The extensive distribution of daily forecasts by means of forecast cards has continued, and the railway, telegraph, and train services have supplied in the aggregate over 5000 railroad stations with bulletins, generally posted in the waiting rooms, for the benefit of employees and the traveling public. The number of addresses on the rural free-delivery list has been greatly decreased as compared with that of the previous year, owing principally to the discontinuance of the afternoon forecast at some of the centers and the transfer of a large portion of this work to the free telephone service. The rural telephone lines are now the best and most economical means of distributing weather information. The forecasts are quickly disseminated, covering a large territory, with little or no expense to the Government. By arrangements made with two of the great trunk telephone lines of Ohio the daily morning forecasts are now available for the use of more than 100,000 subscribers in that State, and the records indicate that nearly one-half of that number have taken advantage of the opportunity to get the forecasts in their homes within a few minutes after their preparation at the district center.

MOUNT WEATHER METEOROLOGICAL RESEARCH OBSERVATORY.

During the past year the main building of the Mount Weather Observatory has been completed, while the power plant, the building from which balloon ascensions and kite flights are to be made, and the magnetic building are being constructed. The physical laboratory for electrical and radioactive effects is being planned, the erection of which will take place in another year. Finally, a comprehensive physical observatory for photographing the sun directly and through the spectrum, for measuring radiation energy by actinometry and bolometry, with their allied equipment, will be required. This complex institution must grow up slowly, as plans can be matured along the best modern lines. When the equipment is ready we shall make and send out apparatus for the exploring of the atmosphere to altitudes of from three to ten miles. It is probable that many balloons will be simultaneously liberated from different stations, so as to get records of storms and cold waves from their four quadrants. With observations from the magnetic, the electric, and the solar physics observatories, opportunity for study will be given to those who believe that the cyclonic and anticyclonic whirls that constitute storms and cold waves are mainly the result of changes in the amount of intensity of some form of solar radiation. It is the purpose to make the research at Mount Weather catholic in its broadness.

WIRELESS TELEGRAPHY.

The Department of Agriculture, through the Weather Bureau, was one of the first of the executive departments to take up, systematically, experimentation in problems concerned with the development of wireless telegraphy. By this action research into the physical problems concerned in transmitting messages through the medium of ether waves was greatly stimulated in this country. Probably one of the best, if not the best, instruments anywhere made for the receiving of wireless messages had its inception in the experimental work of the Weather Bureau. Recently a board was appointed by you to consider the whole problem of wireless telegraphy and the relation of the Government thereto. Its recommendations, which you approved, will result in the discontinuance of experiments along this line by the Weather Bureau, their transfer to the Navy Department, and the transfer to the Weather Bureau of all the meteorological work now being done by the Navy Department.

LONG-RANGE FORECASTS.

It is hoped the time will come when it will be possible to forecast the weather for coming seasons, to specify in what respect the coming month or season will conform to or depart from the weather that is common to the month or season; but that time has not yet arrived, and the officials of the Weather Bureau have been informed that they will best serve the public interests when they teach the communities they serve the true limitations of weather forecasting.

EDUCATION IN METEOROLOGY.

The Department is interested in the general introduction of meteorology into the courses of study provided by the universities and higher technical institutions of the country. The mode of teaching and the results obtained were made an important part of the work of the Convention of Weather Bureau Officials that was held at Peoria, Ill., in September, 1904. At an increasing number of educational institutions Weather Bureau officials, in addition to their regular duties and mainly outside of office hours, deliver courses of lectures on meteorology.

TELEGRAPH SERVICE.

To meet as far as possible the pressing demands for a wider distribution of the daily telegraphic reports of observations, arrangements were perfected during the year for a very generous increase in the number of such reports telegraphed over circuits and as special messages, and while, for economical reasons, it is impossible to satisfy all demands in this respect, it is believed that the present distribution of reports will result in a much more comprehensive display of weather conditions on the maps and bulletins, and will give general satisfaction both to the public and to our officials charged with making district and local forecasts. Submarine cables have been laid from Block Island, Rhode Island, to the mainland; from South Manitou to North Manitou Island, Michigan; from Flavel, Oreg., across the mouth of the Columbia River to Fort Canby, Wash.; and preparations are being made for laying one from North Nags Head to Manteo, Roanoke Island, North Carolina.

The reorganization, at the beginning of the year, of the vessel and wreck reporting service of the Weather Bureau, with additional stations at Sand Key, Florida, and Southeast Farallon, California, has largely added to the effectiveness of this popular feature of the Bureau, and is much appreciated by maritime interests generally. Vessel and wreck reports are now furnished free of charge, except for telegraph tolls over commercial lines, to all corporations and individuals who may apply for them. Besides reporting passing vessels, an important service is rendered by these stations in connection with maritime disasters.

INSTRUMENTAL EQUIPMENT.

The Bureau has now 158 stations completely equipped with instruments by means of which an automatic record is made of the direction and velocity of the wind, the duration of sunshine, the amount and time

of beginning and ending of rainfall, and the temperature and pressure of the air. With one or two exceptions, the stations that are not at present so equipped are of slight importance or, in general, have all the instruments necessary for the satisfactory performance of their work. One hundred and fifty-nine steel towers, with the improved auxiliary equipment for the display of storm warnings, are now installed at as many stations distributed over the shores of the Great Lakes and the Atlantic and Pacific seacoasts. At 77 of these stations high-power electric lanterns are used, and at the others improved oil lights.

AN HONEST LONG-RANGE FORECASTER.

In the MONTHLY WEATHER REVIEW for July, 1904, page 322, under the title "Fake Forecasts," we have expressed our remonstrance against the publication of long-range weather forecasts that pander to the desire of the managing editor of a newspaper for sensational headlines, irrespective of reliability or public welfare. No principles known to conservative, reliable meteorologists warrant the publication of long-range forecasts of the details of local weather. We were very sorry to include in our list of offenders the name of one who has published some good contributions to meteorology; one who has been a close student of the weather map, but who was unwittingly drawn into an attempt to make long-range predictions on a very slender basis and at a very great risk to the good name of science. "Science" is a term that can only be properly applied to facts, observations, principles, and conclusions that are recognized by the world of scholars as acceptable to all because well-founded and generally unchallenged. No one man's hypotheses, deductions, generalizations, discoveries, or theories form a part of the body of "science" until they have been fully published and have stood the test of public discussion. The scientific literature of the past two hundred years, and even of the past fifty years embraces hundreds and thousands of papers that have long since lost whatever importance they once had; in fact both societies and journals are on their guard against publishing that which is useless, to say nothing of being absurd and injurious. Science is conservative, not sensational. Those who publish their ideas first in newspapers, as though afraid to stand the racket of a quiz by their colleagues in the established societies or journals of science, are liable to deceive themselves, mislead the public, and finally come to grief themselves. But we are pleased to find that our friend had committed only the error of an enthusiastic but honest man, and we take great pleasure in publishing the following letter, in which he sets himself right before his fellow citizens and colleagues.—*C. A.*

NORTHFIELD, MASS., *November 11, 1904.*

EDITOR MONTHLY WEATHER REVIEW.

DEAR SIR: It has been brought to my attention that in a recent number of the MONTHLY WEATHER REVIEW I am classed among long-range forecasters who work "against all recognized principles of meteorology." As nothing could be further from the truth, and as I have done no work of a forecasting nature for many months, I should like to correct such a view, for I am diametrically opposed to all such humbuggery, and utterly fail to comprehend where such an opinion had its inception. The only long-range forecaster who ever made regular predictions, whose work seemed to me to have an iota of common sense in it, was your old servant Dunn, [Mr. E. B. Dunn of the Weather Bureau office in New York, not Mr. Lawrence Dunne of Alabama] and I have never looked into his work enough to overcome my prejudices against it on general principles. My own experiments abundantly satisfied me, first, that long-range work as a steady plan of procedure was inoperative, and, second, impracticable unless mixed with guesswork, i. e., lying. You are welcome to use enough of this letter to right the error as regards myself, and, it may be, reaffirm your position, provided that you correctly state my ideas. While I have been requested to give a statement of my position through the columns of widely circulated neutral mediums, I would much prefer to convince those with whom I have long colabored through the official organ which has done me an injustice, though by means of some unknown source of misconception, I have no doubt.

Having corrected, as above, the false impressions that seem to have been created, I will, as briefly as consistent, give the results of my investigations of practical long-range forecasting, which will, I think, reiterate your own private and expressed convictions. I will first state that I wrote the Chief of Bureau in the year 1903 asking if there was no way in which a practical weather worker who had recently passed the age limit, but who had previously passed the meteorological examination by a good number of points, could enter the service, as by reexamination. I received a curt if not a courteous negative. [The Chief of Bureau can not change the rulings of the Secretary of Agriculture or of the Civil Service Commission.] Having the wish to do something of benefit to the community in the field to which I was most particularly adapted, I started a weather forecast business and found, among other things:

First. That the public wants long-range forecasts regularly, and

Second. That it is impossible to make any such with sufficient correctness. I doubt if a Weather Bureau official who has ever made one short-range forecast privately thinks it impossible to make a single long-range forecast. Even the MONTHLY WEATHER REVIEW occasionally hints at the backward extension of great atmospheric changes, lasting perhaps a week—just as the giving away of a dam would slant the level of the water with increasing velocity, beginning at the dam.

Third. The editor of one daily paper carefully studied my three-day forecasts, admitted they were as correct as could be expected for two days, and then wanted them to cover more time as thoroughly. I should recommend that such newspapers try to have Congress appropriate half as much more if they want three-day forecasts, and, still more if they want a few hours' notice given of "tornadoes." People who think it doesn't take money to save money by weather predictions must be ignorant enough to support goose-bone and other theories, including astrology, moonshine, and bombs.

Fourth. The editor of a second daily paper studied my work most carefully and has been writing me ever since to recommence it.

Fifth. Various other editors either wanted me to furnish such stuff very cheaply or else to make exciting predictions, or with impossible regularity, which would necessitate lying. I would not do anything of the kind, and naturally object strenuously to being classed among those who sacrifice honor for profit.

Sixth. The people generally throughout the region covered by the last "cold winter" expect another colder than the average. Here is a whole people making a long-range prediction. Can all the people fool themselves some of the time? Or could a specialist not make such a prediction?

Seventh. As the result of my work, leading reputable papers, etc., began having their own "three-day predictions." Where these have been justified they have been continued. If I proved my three-day predictions were as good or better than 83 per cent correct, why should the Civil Service rules absolutely exclude a man of thirty-five years from his country's service in his chosen and peculiar profession?

Eighth. That the Weather Bureau gets the credit for all such paid for work, where the furnisher does not get part pay in advertising. Thus, if the incog. work is good the Bureau is helped, and if bad, to use the A B C argument, the people relish it or they wouldn't support the paper in using it. When it is not incog., if it is good, it is a reflection on the Bureau for not having such men in its employ, and if bad it should carry its own condemnation. However, in my case, I furnished my own name for the editors to do as they saw fit with, and that leads me to remark:

Ninth. As the Weather Bureau is like the Government "of, for and by the people," can there be harm in discreet persons using it not only privately but publicly if honorably giving it due credit in their work? Wherever I have been the Weather Bureau officials have been helped, (and so the general service,) more than I, by the value of my work. Sensational predictions are almost never justified, though the Minnesota type of a West Indian tornado should have been heralded several hours in advance, if that would not have resulted in more deaths from fright than it would have prevented.

Tenth. An editor in Duluth, Minn., said that all weather predictions were injurious to his paper; if you predict fair the advertisers would have advertised any way, and if you predict rain they wouldn't advertise at all. That argument is about as old as the age of man.

Eleventh. I obtained the most peculiar assortment of ideas from editors from Chicago to St. Louis and Winnipeg, including all sorts of forecasting "from stocks to eternity." Confining myself strictly to weather, it seems that the people "as a whole" have got to be educated "up" to "long-range forecasts" before they can be satisfied with what few they can "gamble on," and the various newspapers who used these generally "kicked" if they couldn't dig out at least a terrible hailstorm or blizzard every time.

Twelfth. I established the great principle that the appearance of a cool wave within the field of observation is the surest sign of all weather changes in that field that short-range predictions can foretell. If I made that fact emphatically understood by those sufficiently conversant the result of my labor is a success.

So as I reluctantly abandoned trying daily long-range newspaper forecasts for that part of North America, preferring honor to money, I would deeply appreciate the favor if you can conveniently set me right again with your readers.

Sincerely,

ALTON D. ELMER.

METEOROLOGICAL COURSE AT WILLIAMS COLLEGE.

In response to an inquiry by the Editor we learn that Prof. Willis I. Milham, Director of the Field Memorial Observatory

of Williams College, maintains an excellent course in meteorology.[1]

This course occupies the first half year of each annual session. It is based on Davis's Elementary Meteorology, but much outside material is given in the form of lectures. In order to systematize the work, a syllabus covering both textbook and lectures is closely followed, but in this the order of topics is rearranged from the work by Davis to suit the needs of Professor Milham's classes.

Additional practical laboratory work is also imposed, consisting in the use of apparatus for observations, work on meteorological statistics, essays or short theses on special subjects, and work with the weather map in making forecasts. The following is the first page of the list of problems relating to statistics:

Monthly extremes of temperature for March, April, and May at Williamstown, Mass.
Monthly extremes of temperature for July, August, January, and February at Springfield, Mass.
Ice days at Amherst, Mass.
Normal absolute yearly range of pressure at Amherst, Mass.
Difference in temperature between Amherst and Williamstown, Mass.
Freezing days at Amherst, Mass.
Constancy of mean annual temperature at Amherst, Mass.
Extremes of temperature for January and July at Albany, N. Y., as compared with those at Williamstown, Mass.
Monthly extremes of temperature for July, August, January, and February at New Haven, Conn.
Monthly extremes of temperature for December, January, and February at Williamstown, Mass.
Extremes of temperature for July and January at New York, N. Y., as compared with those at Williamstown, Mass.
Difference in temperature between Albany, N. Y., and Williamstown, Mass.
Monthly extremes of temperature for July, August, January, and February at Minneapolis, Minn.
Difference between mean monthly temperatures computed from hourly observations and $\frac{1}{2}$ (max. + min.) at Amherst, Mass.
Annual barometic variation at Amherst, Mass.
Monthly extremes of temperature for July, August, January, and February at New York, N. Y.
Monthly extremes of temperature for June, July and August at Williamstown, Mass.
Monthly extremes of temperature for September, October, and November at Williamstown, Mass.

The following list contains some of the special topics on which essays must be written by the students.

Lightning.	Maximum and minimum thermometers.
Waterspouts.	Ocean and lake temperatures.
Blizzards.	Tornadoes.
Artificial rain.	Weather proverbs.
Foehn and chinook.	Sunspots and rainfall.
Sunset colors.	Snow line.
Thermometer shelters.	River stages.

During the current winter the students and various voluntary observers will carry out a special investigation into the distribution of abnormal low temperatures in neighboring valleys and the vertical temperature gradient during still clear nights.—*C. A.*

WEATHER BUREAU STATION AT CHARLES CITY, IOWA.

By CLARENCE J. ROOT, Assistant Observer.

A new Weather Bureau station was opened at Charles City, Floyd County, Iowa, on November 1, 1904. The longitude of Charles City is 92° 38′ W., latitude 43° 04′ N., and elevation 1015 feet above mean sea level. The city is situated in the valley of the Cedar River and is partially surrounded by hills ranging in height from 50 to 68 feet above street level. The station is located one block from the river. It is furnished with a full instrumental equipment, the wind instruments and electrical sunshine recorder being mounted on a 50-foot steel tower, in the base of which the thermometer shelter is suspended. The rain gages have a ground exposure in the yard. Two observations will be taken daily and the usual records kept.

[1] It was at Williams College that the eminent meteorologist, Prof. John Henry Coffin, was professor of natural philosophy, 1839–1843, and here he established our first mountain observatory for meteorological work, i. e., that on Mount Greylock, where continuous self-registering instruments were maintained for two years. "Coffin's Winds of the Northern Hemisphere," Smithsonian, 1851, is still one of the great storehouses of data relative to both the upper and lower clouds and the winds. The elaborate work, "Winds of the Globe," 1873, was quite an epoch in American meteorology. Professor Coffin was born in Northampton, Mass., 1806, September 6, and died in Easton, Pa., 1873, February 6. He was a graduate of Amherst College, and, after leaving Williams College held the position of professor of mathematics and astronomy in Lafayette College at Easton, Pa., until his death, when his son, Selden J. Coffin, succeeded him.

METEOROLOGY IN NEW SOUTH WALES, AUSTRALIA.

Two important steps looking to a higher appreciation of meteorology have lately been taken in Australia. The first relates to the introduction of the so-called nature study in the public schools. In February last the Department of Public Instruction issued a syllabus of instruction to guide the course pursued by the teachers in schools under that department. This gives suggestions and instructions as to methods of teaching in the different grades from the kindergarten to the seventh class, or children of the age of fourteen or fifteen. Throughout this course the observation of nature is inculcated. Thus, in the lowest or first class the beginners receive a series of lessons on plant and animal life, and cultivate plants and flowers in the ground or in pots, observing the various stages of development. They use sand trays for modeling representations of the geographical features; they observe the appearances of the sky. In the second class the same course is pursued, but is applied to more difficult subjects. The observation of sky phenomena is continued and the effects of seasonal changes are observed. In the third class "Observing and recording simple meteorological phenomena and seasonal changes, with lessons based on these observations." In the fourth class we read "Physical features associated with the chief towns, with climatic conditions and commercial products; lessons on climate and atmospheric phenomena." In the fifth class "A course of experimental lessons in some branch of elementary science; lessons bearing on agricultural pursuits, with such scientific principles as will enable the pupil to understand the reasons, etc.

The whole course is adapted to direct the attention of the youth toward the studies and sciences that have a practical application in everyday life.

The second important meteorological feature is a so-called new departure, namely, the publication of a daily weather chart in the Daily Telegraph, which is the principal newspaper of the colony. We are indebted to Hon. Andrew Noble for copies of the Daily Telegraph of October 12, 13, and 14, containing the very first charts with isobars and winds. Such charts will undoubtedly educate the people to a condition of intelligence that ought to render impossible a repetition of the numerous rain-making schemes and other evidences of deplorable ignorance that were manifested during the recent terrible and disastrous drought. We quote the following from the Daily Telegraph of October 12.

The inclusion of meteorology in the new public schools syllabus has directed special attention to consideration of weather conditions. Correspondents, including a number of public school teachers, have applied to the Daily Telegraph for amplified daily information on this subject and the meteorological branch of the Sydney Observatory also has been requested to furnish details of the weather conditions and atmospheric pressures, the information upon which the weather forecasts are made.

The Daily Telegraph has arranged to publish daily a chart showing the principal features of weather conditions, including the high and low pressure isobars. Where possible the rainfall area will be indicated, and conditions on the coast will also be given.

This chart will be prepared from information supplied by Mr. H. A. Hunt, the acting meterologist of this state. The publication of isobaric charts will enable students with their local knowledge of physical surroundings to anticipate in detail their probable weather more completely than is possible at the central office, where precise knowledge of local

peculiarities is lacking. In framing forecasts at the observatory, Mr. Hunt explains, a wording is used sufficiently comprehensive to apply as nearly as possible to the whole of the state, and until detailed topographical charts are available, it would be useless issuing other than general forecasts.

INFLUENCES ON AUSTRALIAN WEATHER.

Briefly describing the origin of Australian weather, Mr. Hunt recently explained that in the latitude of Australia the general movement of the air is from west to east; in fact, there is a great atmospheric stream always traveling eastward. This stream varies in velocity relatively from a few miles at the earth's surface, where friction retards motion, to a very much greater velocity in the higher levels. This easterly drift is by no means uniform in motion, but is divided up into a number of irregularities, known as anticyclones and cyclones or barometric highs and lows, respectively. To the anticyclone must be given first place as the great control system, determining the air movement which gives us our weather in the Southern Hemisphere.

"Although our rainfall is more immediately due to ascending convectional motion within the cyclone, it must be remembered that the energy of the latter is largely derived from, and its position governed by, the former, to which it acts the part of a secondary. These anticyclones or controls travel eastward with a normal daily velocity of 400 miles, but there are wide departures from this normal and sometimes the easterly translation for a single day may be as much as 1000 miles, and there may be within the lower levels, so far as the position of Australia is concerned, no forward movement of the atmospheric stream, when the anticyclone remains stationary for days over our mainland, as often occurs during the winter months, or there may be an actual retrogression, but any backward movement rarely lasts. All our weather phenomena may be said to be due to the varying intensity, and to the altered position day by day of these high and low pressure areas."

THE CHART EXPLAINED.—INTERVIEW WITH THE ACTING METEOROLOGIST.

The acting meteorologist (Mr. H. A. Hunt) furnishes the following details respecting the publication of a daily isobaric chart:

"The curves on the above chart represent lines of equal barometric pressure, known as isobars, and are drawn through simultaneous barometer readings received daily from 90 or 100 stations throughout Australia. These are carefully plotted on blank maps, after corrections for varying temperature and altitudes have been applied, together with those for index and gravity. If these charts are carefully studied from day to day, it will be noticed that a general translation takes place to the eastward with varying rates, occasionally halting, and in remote instances showing a retrogression. It will also be observed that at times the whole of the systems, anticyclonic, and cyclonic, are occasionally impelled to and from the equator.

"The pressures (high and low) which for the moment are lying over Australia, constitute a link in a vast atmospheric stream or belt surrounding the earth, which is fed by return currents from the equator and the poles. A like belt exists in the Northern Hemisphere in a similar zone. The mean latitude in which these belts travel varies with the seasons, and they are drawn to and from the equator as the sun goes north and south. Mr. Russell, in his paper on 'Moving Anticyclones in the Southern Hemisphere,' determined the mean easterly rate of progress at 400 miles per day, any variation in which rate brings about a break in the normal weather sequence, as also does a variation of path from the normal latitude for each period of the year.

"Were the rate and latitude of this belt constant, weather anticipations would be a very simple matter, but these occasional deviations render them very complex.

"The normal cyclonic systems of the Southern Hemisphere take the form of depressions, in shape not unlike an inverted capital letter V, the apex of which forms a wedge between the links or anticyclones in the anticyclonic belt. The isobars of these low pressures undergo a straightening in high latitudes, until they become parallel, and control the westerly trade winds, familiarly known as the 'Roaring Forties.'

"Similar isobaric formation exists in the equatorial zones, the monsoonal Vs or wedges extending southward between the anticyclones from the tropical low-pressure belt, more especially during the summer months.

"Occasionally these V-shaped depressions extend so far northward or southward by reason of occasional variations in the movements of the anticyclones—a neutral or dormant area intervening—that with an acceleration in the rear high-pressure system a portion of the V-pressure system is apparently imprisoned between the two anticyclones, and a violent cyclone is the result, such as caused the recent Nemesis storm. This is one of the principal causes giving rise to cyclones in the Southern Hemisphere, another being what is known as a backing or retrogressive movement, which is brought about in the following manner: An anticyclone, moving eastward, collides with a V-shaped depression that for some as yet unexplained reason has remained stationary, or a depression backs on to the easterly isobars of an advancing anticyclone. Both actions give rise to a steepening of gradients, with violent wind results. One memorable instance of this type is that known as the Ballarat storm in 1892, when a V-shaped depression over the Tasman Sea backed on to a high pressure to the west of Tasmania. Other instances with like eventuations occur when incipient depressions visit the coast of New South Wales from the northeast tropics, resulting in violent cyclones such as caused the Maitland gale."—*C. A.*

HAWAIIAN CLIMATE AND CROP SERVICE.

We learn from Mr. A. McC. Ashley, Section Director of the Weather Bureau at Honolulu, that he is now receiving reports from 116 stations in the Hawaiian Islands, distributed as follows: Hawaii, 42; Maui, 18; Oahu, 25; Kauai, 28; Molakai, 1; Lanai, 1; Kahoolawe, 1.

Only 23 of these, including the last three on the list, are equipped with thermometers, but this number will be materially increased. Many of these stations reported to the former Territorial Service, but the exposure of the rain gages and the preparation of reports has been to some extent lacking in uniformity, and Mr. Ashley will endeavor to reduce the whole to a homogeneous system. It is hoped that the publication of regular monthly reports may begin early in 1905.—*F. O. S.*

ANTARCTIC METEOROLOGY.

At the recent International Geographic Congress, whose meetings where held in Washington, New York, St. Louis, and elsewhere, the antarctic explorer, Mr. Henry Arctowski, who had charge of the recent Belgian Antarctic Expedition, delivered an interesting address, from which we make the following extracts:

Only a few years ago we knew nothing, or nearly nothing, of the antarctic climates, as the first wintering in the south polar regions was that of the *Belgica*, which only dates from 1898.

The publication of the results of our meteorological observations is at last nearly completed, and the five reports already published on the hourly meteorological observations—on the clouds, on snow and frost, on optical phenomena of the atmosphere, and on the aurora australis—make it possible to judge of the contribution to antarctic meteorology brought back by the Belgian Antarctic Expedition.

The study of the results which we have obtained convinces me that all this work is only the wedge started into the unknown, and from this critical point it is fortunate that the expedition of the *Belgica* was followed so closely by those others which have in such a short time enriched our knowledge by great geographical discoveries and a mass of scientific material, the publication and discussion of which shall, unfortunately, take many years. But, notwithstanding all the importance of the results obtained by the *Belgica*, *Southern Cross*, *Gauss*, *Discovery*, *Antarctic*, and the *Scotia*, I consider the whole of these new acquisitions to science as being only a work of orientation—provisory work.

If all the expeditions, in whose happy return we rejoice, had wintered simultaneously, and if they had been seconded by stations, which could have been easily installed on the subantarctic islands, the discussion of the whole of those observations would probably have revealed not only the exact position of the isotherms and the isobars all around the south polar ice cap, but also the course of the tempests, and, perhaps, even the laws of the general circulation of the atmosphere in the Antarctic; whereas, on the contrary, because of the conditions in which the several winterings were made, we shall only have climatological data and a series of questions simply touched upon but not resolved in everything concerning the dynamique of the atmosphere.

The thing is to have as great a number of stations as possible working, all simultaneously, not only in view of accumulating the figures resulting from the ordinary hourly meteorological observations, but, first of all, in view of enriching our knowledge of the meteorological conditions of the upper regions of the atmosphere by experiments with self-registering instruments mounted on kites and by continuous study of the clouds, especially of their height and the direction and speed of their displacement.

The stations must be sufficiently near one another to permit, after the return of the expeditions, the drawing of daily synoptic maps, or even hourly, for the most interesting cases, and it is only under such conditions that we shall succeed in learning the usual tracks of the cyclones which are observed in the subantarctic regions all around the polar ice cap, and about the displacement of which we do even know whether they converge toward the pole, following a spiral track, or if, on the contrary, the depressions are formed on the borders of the ice (there where the isotherms are very close together) and go, leaving the polar circle, in a northwestern direction. The clouds, as well, must be studied very carefully, so that the distribution of the systems of clouds in the barometric depressions may be established exactly, and in this respect the Antarctic regions may give us very precious information.

From the detailed study of the clouds that Dobrowolski undertook and carried out on board the *Belgica*, we can deduct that those cloud

masses which he has called "system clouds" form huge layers, generally discontinuous (at least at their borders), where the undulations may be distinctly observed.

The clouds show us the long waves which must necessarily be formed between two layers of air sliding one over the other and between which clouds are interposed.

However, Dobrowolski's work should be continued, and the only way to bring it to a satisfactory end and to resolve the fine problems of atmospheric dynamics which are still awaiting a definite solution is to have good observers distributed at a series of stations sufficiently close together so that the same system of clouds might be studied simultaneously through its whole extent. If we look forward into the question of the scientific exploration of the Antarctic regions the idea of an international cooperation, of the concentration of all efforts toward one and the same end, this idea must necessarily pursue us.

The Cape Horn region and the lands situated farther south seem to me very favorable for the establishment of a polygon of stations, the chosen places being Falkland Islands, Staten Island, one of the islands of Diego Ramirez, and the lighthouse of Los Evangelistas; then the South Georgia, Sandwich, Orkney, and South Shetland islands; lastly, a station on the coast of Graham Land, another at the wintering station of Nordenskjöld, for example, and two floating stations—one in the region of the drift of the *Belgica* and the other in the Weddell Sea. We would have in this way a polygon of posts of observation sufficiently large, and composed at the same time of points sufficiently near together.

The expenses of such an undertaking might be counted as follows:

A ship wintering in the ice in the region of the drift of the *Belgica*, $100,000.

A second ship in Weddell Sea, $100,000; a third, exploring the edge of the pack and studying the variations of the distributions of the ice and making oceanographic researches during the whole year, $100,000.

The first and second may install each a station on the Antarctic lands, and the third, in two cruises, the four stations on Sandwich, Georgia, Falkland, and Shetland islands—let us count six stations at $30,000 each.

And, lastly, as for the region of Cape Horn, there is already a good meteorological station on the Island Año Nuevo, near Staten Island, while that one of the lighthouse of Los Evangelistas would probably need a special staff and instruments, and so let us simply count Diego Ramirez, $20,000, and a mountain station, for example, on the summit of the mountain called Bonnet de la République, near Llopotaia, the installation and all the working expenses of which would not exceed $30,000.

The entire expenses of such an undertaking, then, would not, as you see, exceed $530,000.

If you will bear in mind that this expense would be divided between the different nations taking part in this expedition, and that, aside from the meteorological work, other researches, oceanographic, etc., would certainly be undertaken, you will see that the proposition which I submit could be easily realized, and that our knowledge of the physical conditions of the globe would be enriched by an enormous amount of new scientific data, for the acquisition of which it is worth while to sacrifice the money and necessary efforts.

DEFLECTION OF THUNDERSTORMS WITH THE TIDES.

CAPE MAY COURT HOUSE, N. J., *November 9, 1904.*

Prof. WILLIS L. MOORE,

Chief of U. S. Weather Bureau, Washington, D. C.

SIR: In the August issue of the MONTHLY WEATHER REVIEW, I note, with interest, an article from Mr. George L. Lovett, of Cape May, N. J., regarding the deflection of thunderstorms by the tides as they pass up and down the Delaware Bay.

I wish to concur with him as to the facts as stated, from several years' observation.

It is a common occurence, during the summer months, to witness heavy cumulo-stratus clouds passing up the bay with the rising tide, and down the bay with the falling tide, but more frequently do they pass up. At Cape May Court House, N. J., which is twelve miles from Cape May and about three miles west of the ocean, it is seldom we have a thunderstorm simultaneously with a falling tide, but usually with the beginning or on top of the flood tide. If, as occasionally occurs, a storm comes on the ebb tide, it is generally heavy and accompanied with dangerous lightning and heavy winds. It is the invariable practise of our baymen, on observing a "squall rising" as they term it, during the ebb tide, to seek shelter before the flood tide makes, when they look for the storm to break forth.

Another phenomenon is, that thunderstorms more frequently either follow the Delaware Bay or cross the cape in close proximity to the Tuckahoe River basin.

Cape May Court House is nearly midway between Cape May on the south and the Tuckahoe River on the north. Now, on the ebb tide, when storms are passing down the Delaware, they are liable to either cross the cape in the vicinity of Woodbine and pass down the Tuckahoe River basin, with the tide to the ocean, and on the flood tide from the ocean across the cape to the bay, or pass down the Delaware past Cape May, thus avoiding a belt across Cape May County, with Cape May Court House as the center.

This is evident by the following normal annual precipitation as given in the annual report of the New Jersey Weather Service: Ocean City, 1900, 43.94 inches; Atlantic City, 1903, 43.71 inches; Woodbine, 1903, 43.68 inches; Cape May, 1903, 43.88 inches, and Cape May Court House, 1903, 41.13 inches.[1]

From these figures it will be observed that Ocean City, situated near the mouth of the Tuckahoe River, receives a larger rainfall than either Atlantic City at the north or Woodbine or Cape May Court House at the south; that Woodbine, being situated farther from the river, receives less rainfall; that Cape May situated at the cape receives a large rainfall, and that Cape May Court House, being in the center of the belt, receives the least rainfall. On investigation of the reports it will be found the difference is noted during the summer months, or during the thunderstorm period, thus showing that the thunderstorms follow the rivers with the tides.

Yours, very respectfully,

L. T. GARRETSON,
Voluntary Observer.

WEATHER BUREAU RECORDS.

By virtue of Instructions No. 210, dated December 16, 1904, a number of changes will be made in the forms and records, which must be carefully considered by those of our colleagues throughout the world who are studying Weather Bureau data. Perhaps the most troublesome change is that depending on the adoption of local standard hour meridians instead of the uniform seventy-fifth meridian time that has been so convenient for meteorological, magnetic, and seismic work. We make the following extracts from the report of the board on the revision of forms, which report goes into effect January 1, 1905:

1. The adoption of a form to be known as the Daily Local Record. * * * This form provides for the entry of the hourly temperature readings; the hourly amounts of precipitation, with the time of beginnings and endings; the hourly sunshine; the hourly wind direction and velocity, and the hourly maximum wind velocities when above a certain limit, which limit will vary for the different stations. It also provides for entering the character of the day, the total sunshine in hours, prevailing wind direction, and other data; and a diagram is provided on which the daily temperature and pressure curves may be platted, if desired. Space is also provided for the entry of abnormal conditions, severe storms, and other matter not expressed by the instrumental readings. An extra horizontal column, without heading, has been provided for the entry of data of excessive precipitation, now recorded on the back of Form 1017-Met'l, or other data, a record of which may be of sufficient importance to retain at the station. In short, it has been the aim to embody in the Daily Local Record form a complete history of the weather of the day. * * *

2. In the matter of compiling the hourly readings of the various instruments the board is of the opinion that sufficient compilations of the hourly barograph readings have been made, and it therefore recommends that Form 1026-Met'l, Barograph, be discontinued on December 31, 1904, at all stations now rendering said form. In regard to temperature the board is of the opinion that this element, aside from its purely climatic value, has sufficient public interest to warrant the tabulation of hourly values, as at present, but after tabulations are made and means found for a period of twenty years no further sums and means of the daily and hourly values need be made.

The hourly records of wind direction and movement are important, especially to Lake and sea-coast stations, and at some points in the interior. Since frequent changes in the exposure of wind instruments have been made in the past, and since it is probable that such changes will continue to be made in the future, the matter of determining monthly and seasonal normals becomes exceedingly difficult. Each exposure of the anemometer forms, in itself, a separate and distinct record, and should be treated as such. Unless a series of comparative readings are made between the old and new exposures a combination of the two series in a general mean is not satisfactory. Therefore, when a removal is to be made, a series of comparative readings, extending over at least a year, should be made whenever practicable. It is believed that these data should continue to be tabulated as at present. At those stations where an undisturbed and continuous exposure has been had for a period of ten or fifteen years, it is quite probable that fairly accurate normals could be obtained, and those stations might be authorized to cease computing sums and means.

3. Form 1001-Met'l. The board recommends the adoption of a new Form 1001-Met'l. * * * The new form retains pages 2, 3, 6, and 8 of

[1] These normals are based on the following length of record: Ocean City, eleven years; Atlantic City, twenty-seven years; Woodbine, eleven years; Cape May Court House, fifteen years. The normals are therefore not comparable with one another.—*F. O. S.*

the present form substantially as they are. These pages, it may be remembered, provide for the 8 o'clock and special observations. The last-named page has been brought forward and takes the place of the instructions which now stand on page 4 of the present form. Page 5 of the present form, "Wind, number of miles and length of time from," has been stricken from the new form.

The board recommends that no further compilation be made of the data now recorded on page 5, Form 1001-Met'l, after December 31, 1904. The new form contains four additional pages on which it is proposed to enter the hourly temperatures, the hourly wind directions and velocities, and the hourly sunshine. These four pages replace the present Forms 1026-Met'l, Thermograph; 1021 Met'l, Hourly Wind Direction; 1022 Met'l, Hourly Wind Velocity, and 1070-Met'l, Hourly Sunshine. In other words the board has consolidated with Form 1001-Met'l four additional forms, and has thus brought together, in compact shape, information that is now carried on four different papers. The board desires to invite attention to the fact that the adoption of the above recommendations obviates the necessity of press copying the forms just mentioned.

The copy of Form 1001-Met'l retained at station will contain only a record of the observations at 8 a. m. and 8 p. m. (seventy-fifth meridian time), the special observations, and the summary of temperature and precipitation on page 8, except that the beginnings and endings of rainfall will not be entered on the last-named page. The beginnings and endings of rainfall will appear on the Central Office copy, however, in seventy-fifth meridian time, and the total precipitation there given will be for the period midnight to midnight, local standard time.

* * * * * * *

6. The board recommends that all instrumental records and the Daily Local Record be kept on *local standard time*, but that all data intended for the Central Office shall be recorded on seventy-fifth meridian time, except that the hourly temperature, the hourly records of wind velocity and direction, and the hourly sunshine shall be entered on local standard time.

7. The board recommends the discontinuance of the present form of Daily Journal and the substitution therefor of * * * a report to contain a description of unusual or remarkable atmospheric phenomena that have been observed during the month, and any matters that seem to call for special mention. It is not the intention that entries shall be made for each and every day of the month, but rather that a succinct narrative be given of the important events of the month, such as the occurrence of severe storms, cold waves, thunderstorms, or the prevalence of abnormal conditions extending over several days. It is believed that a copy of the notes made for the Daily Local Record will, as a rule, meet the requirements of the Central Office. This shall be known as the Monthly Meteorological Report.

8. The board recommends that the following data be no longer recorded:

(1). Extreme wind velocity. This information is of doubtful value. It must always be accompanied by a statement of how it was obtained, and it is liable to be confused with maximum velocities for five-minute periods; moreover when high velocities are attained it is difficult to accurately read them from the wind sheets.

(2). Number of days with mean temperature below 14° and 32°, and above 41°, 50°, 59°, 68°, 77°, and 90°, as recorded in the summary of Form 1001-Met'l, Form 1002-Met'l, and the Means Book. These data have been compiled for a number of years. They have not yet been used, so far as known to the board, in any manner. They can be obtained, if desired, from other records, and it is therefore believed that time and space can be saved by discontinuing their further compilation.

* * * * * * *

10. The board recommends that the present Means Book be known, hereafter, as the Climatological Record. It further recommends that the manner of entering the data therein, or the form of the volume, be changed as follows: Instead of entering the several elements for each month consecutively on seven pages, as at present, let them be grouped under several general heads, as Pressure, Temperature, Precipitation, etc., according to the character of the data, and entered separately.

* * * * * * *

Finally, the board believes that the Climatological Record should contain the following data:

Pressure (reduced to sea level).—Highest; lowest; mean; absolute monthly range.

Temperature.—Monthly mean, departure from the normal; mean monthly maximum and mean monthly minimum; absolute monthly minimum and date; absolute monthly maximum and date; mean daily range; greatest daily range; absolute monthly range; mean monthly variability; lowest monthly maximum; highest monthly minimum; number of days with maximum 32°, or below, and 90°, or above; minimum 32°, or below, and zero, or below.

Relative humidity.—Mean a. m. and p. m.

Precipitation.—Total amount for the month, departure from normal; greatest amount in twenty-four hours, amount and date; one inch an hour or over, total amount and date; 2.50 inches in twenty-four hours, amount and date; number of days with .01 inch and over, .04 and over, .25 or more, 1.00 or more; total depth of snowfall; number of days with snow; snow on ground at end of month; greatest snowfall in twenty-four hours; greatest depth of snow on ground and date.

Wind.—Total movement; prevailing direction; average hourly velocity; maximum velocity, direction, and date.

Weather.—Actual hours of sunshine, percentage; average cloudiness, a. m. and p. m.; number of days clear, partly cloudy, cloudy; number of days with fog or hail; thunderstorms; auroras; solar halos; lunar halos.

Daily and hourly data.—Daily maximum, minimum, and mean temperature; daily precipitation; daily snowfall; hourly values of pressure, temperature, wind, and sunshine.

* * * * * * *

Before closing this report the board desires to urge the importance of devising some method of recording the cloudiness at night and the beginnings and endings of light precipitation. The board recognizes the very great importance to stations of retained copies of the wind sheets, Form 1017-Met'l. It is understood that as yet no means have been devised whereby such copies can be had. The hope is expressed that the Instrument Division of the Central Office may be able to take up the problem and eventually solve it.

WEATHER BUREAU MEN AS INSTRUCTORS.

Prof. H. J. Cox, Chicago, Ill., delivered an address upon Recent Advances in Meteorology before the earth science section of the Central Association of Science and Mathematics Teachers at its fourth annual convention, held in Chicago, November 28.

Mr. H. W. Richardson, Local Forecaster, Duluth, Minn., reports that a class of about twenty students from the Blaine High School of Superior, Wis., visited the Weather Bureau office at Duluth on November 21. After showing the visitors the instrumental equipment, Mr. Richardson gave them a somewhat extended, though informal, lecture upon the general work and methods of the Weather Bureau.

Mr. J. P. Bolton, Observer, Fresno, Cal., lectured on November 28 to the physical geography class of the Fresno High School.

Mr. E. C. Vose, Section Director, Parkersburg, W. Va., is conducting a course of study in practical meteorology for the class in physical geography of the local high school. The study began early in November, and forty minutes each week are devoted to the work.

Mr. George T. Todd, Observer, Wichita, Kans., on November 17 and 18, 1904, addressed the high school class in physical geography, which came to the office in two sections. The instruction consisted of an explanation of the instruments, weather maps, and charts, the value of the records, and some remarks on weather forecasting.

ASSMANN'S SOUNDING BALLOONS AT THE ST. LOUIS EXPOSITION.

It is generally known that some years ago the Weather Bureau prepared to undertake a series of balloon ascensions to great heights from some point in the interior of the continent, but that owing to a change of plan the Bureau is now preparing to make these ascensions first from Mount Weather.

Meanwhile the aeronauts of the German meteorological office brought to this country for exhibition a very complete collection of balloon apparatus, and with this apparatus the officials of the Blue Hill Observatory have made a number of soundings from the grounds of the World's Fair at St. Louis. Four balloons were sent up in September, reaching altitudes of nine or ten miles, and all of the records were secured. The balloons are what are called Assmann's expansible and exploding balloons. They are made of thin India rubber, about a yard in diameter, and burst when the pressure of the gas inside, relative to that on the outside, has distended the balloon sufficiently to burst it. The balloon being free is carried hori-

zontally by the wind. In the four experiments at St. Louis in the month of September all descended within fifty miles of St. Louis. In ten ascents during November and December the balloon traveled much farther, reaching 200 miles from St. Louis. In general it would seem that even in midsummer, at altitudes above four miles, there are perpetual freezing temperatures, and an upper air current blowing steadily from the west. The Blue Hill Observatory is again to be congratulated on the energy it shows in the matter of upper air observations, and it is to be hoped that Mr. Rotch will be able to continue the balloon work at St. Louis. Many such stations will be needed in order to perfect our knowledge of the atmosphere over the United States.—*C. A.*

TRAILS OF METEORS.

A newspaper clipping from Portland, Oreg., says:

Residents of the Knob Hill district going home last night (December 21, 1904), shortly after 6 o'clock were startled by the appearance out of the cloudy air of a meteor with a trail of fire behind it, flying close over the city, apparently not over 150 feet above them. It was glowing red and threw out sparks behind like the tail of a comet.

The quotation relates to a phenomenon that would give us much information about the upper atmosphere if only the observers would give us a more exact account of what they saw. The smokelike trail left behind by a meteor is undoubtedly higher up in the air than any altitude attained by balloons, and the changes that it undergoes must be supposed to depend, at least in part, on the atmospheric conditions in its neighborhood. What the meteorologist wants is a sketch, as exact as possible, of the location of the trail among the stars. Several successive sketches, stating the moments of time, and the apparent angular altitude, and the bearing or azimuth, would give us the basis for some calculation as to atmospheric influences. When several observers happen to see the same meteor from different points of view, their separate sketches of the trail would give us still more interesting results. A large collection of data of this kind has been made by Mr. W. P. Trowbridge of Columbia University, New York, N. Y., and every additional sketch would be highly valued by him.—*C. A.*

DARKNESS AT MEMPHIS.

From a newspaper clipping we learn that on December 2, about 10 a. m., a dark pall covered Memphis for about fifteen minutes. The sunlight was wholly cut off by a dense cloud and the darkness of night prevailed. Of course artificial light was used and business temporarily paralyzed, but the light returned as suddenly as it went. We are told that in some quarters a panic prevailed, and that some were shouting and praying, imagining that the end of the world had come. A similar darkness frequently attends a heavy local cloud, and is a common attendant upon prairie and forest fires and upon volcanic eruptions; everyone is familiar with the accounts of the great darkness attending the fogs that prevail in London during the winter season, and with less intensity in New York, Philadelphia, Chicago, and other large cities where soft coal is used.

Every intelligent person understands that such darkness gives no occasion for superstitious fears. However, we must recognize the fact that there are some in every class, ignorant or educated, American or foreign, rich or poor, who are liable to loose self control when anything very unexpected occurs. A panic is almost as easily precipitated among men, women, and children as it is among herds of animals. For the Weather Bureau men it should be a proud record that they have stayed many panics by words of assurance and a cool bearing. We ought never to forget that every natural phenomenon has a natural cause, and requires to be considered and treated calmly. No matter what the impending disaster, the first requisite is to preserve one's self-possession and help others to do the same.—*C. A.*

FLOOD ON THE SOUTH CANADIAN RIVER, IN OKLAHOMA AND INDIAN TERRITORY, OCTOBER 1-4, 1904.

The Canadian River rises in eastern New Mexico and flows across the panhandle of Texas into Oklahoma and Indian Territory, where it joins the Arkansas. In the preceding number of the MONTHLY WEATHER REVIEW, page 466, we published an account of the floods in New Mexico due to heavy rains in that Territory from September 26–30. The resulting flood during the first days of October on the Grand River, below the point where it enters Oklahoma, is described in detail by Mr. C. M. Strong, Section Director, in the October and November reports of the Oklahoma and Indian Territory section of the Climate and Crop Service of the Weather Bureau. That the flood originated in the mountains of New Mexico is shown by the fact that only in that State were there any heavy rains on the Canadian River basin between September 25 and October 4. Mr. Strong states:

The flood of the South Canadian River of October 1 to 4, 1904, will stand memorable as the most destructive one in the history of this section since its settlement. To thoroughly understand its destructive effects one must have a knowledge of the topographical features of that stream.

Finding its source in the mountain ranges of New Mexico, it thence meanders southeastward across the high uplands of the Texas panhandle to the fertile plains of Oklahoma, and on through the Indian Territory to its connection with the Arkansas River.

Throughout its course its bed lies inclosed in a wide valley, whose bottom levels are but slightly above the surface of the stream. Its waters are usually shallow, of small width, and to a large extent are underground throughout the year, the usual width of the surface stream varying from 60 to 200 yards.

Previous to the flood the river valley was covered with fertile farms from its entrance into Oklahoma to its mouth in the Indian Territory, rich with fields of cotton, corn, and wheat.

Conceive in your mind this beautiful and fertile valley, rich in the finest products of the earth, and then turn to the results following the flood.

The feeble stream, winding its way in a shallow bed, became a vast flood that rolled a wall of water eighteen to twenty feet deep, in places spreading from hill to hill, with width varying from one to two miles, sweeping everything from its path and covering the valley with sand from one-half to four feet in depth, completely obliterating everything in the form of vegetation.

The force of the water was so tremendous that nothing could stand in its course; crops, bridges—both iron and wooden—trees, and houses were swept away like straws and swallowed up in the sands. The roar of the waters was heard for miles on either side, like that of the sea.

The scene along the full course of the river beggars description. The fertile valley is to-day practically destroyed, and its heretofore valuable farms are worthless, as the sand with which they are covered can never be removed. Many of the farmers are left destitute, nothing of any value remaining after the flood.

The flood originated in the mountains of New Mexico, and in successive waves swept the full course of the river, indicating that terrific cloudbursts were the cause of the phenomenon.

During the progress of the flood over this section the weather was generally clear and pleasant, alleviating to some extent the suffering that was caused to the people made homeless by its destructive effects.

The nearest estimate that can be made of the damage caused is as follows: Loss to personal property, crops, and bridges, $600,000; loss to farms by overflow, $3,000,000.

At Stone, Okla., where before the flood there was merely a dry bed of sand about half a mile wide, the river attained a depth of twelve feet and width of two miles. At Bridgeport, Okla., the river rose slowly all day on the 1st, and by the morning of the 2d was six feet above the normal. It continued to rise slowly on the 2d, and at 5 a. m. on the 3d a wave eight feet high struck the railway, washing out three-fourths mile of embankment on the Choctaw Railroad and one and one-half miles on the Rock Island Railroad. Thirty quarters of 160 acres each were covered with sand to a depth of from two to four feet, and some are completely washed away. The following table is based on reports from postmasters and others at the places mentioned.

The distances given in the second column are obtained by measurements on a postroute map, following the windings of the river as closely as practicable. According to the contour map of the U. S. Geological Survey, the elevations on the

river are approximately as follows: 2000 feet, about 24 miles above Grand; 1500 feet, midway between Taloga and Thomas, 1000 feet, four miles above Union; 500 feet, 35 miles below Garner.—*F. O. S.*

Depth and width of the Canadian River during the flood of October 1-4, 1904.

[Stations are arranged in order from above toward the mouth.]

Stations.	Distance from preceding place.	Greatest depth.	Average width at highest stage.	Width before flood.
	Miles.	*Feet.*	*Miles.*	
Grand, Okla.		15	1¾	¼ mile.
Stone, Okla.	33	12	2	Dry.
Taloga, Okla.	41	*	¼ to 2	
Thomas, Okla.	29	12	1	30 feet.
Ethel, Okla.	8	†	1	50 yards.
Thompson, Okla.	10	19½	1½	60 yards.
Bridgeport, Okla.	6	18	1½	125 yards.
Niles, Okla.	17	18	1½	50 feet.
Union, Okla.	15	18	4	60 yards.
Mustang, Okla.	13	30	1	500 feet.
Noble, Okla.	30	20	1½ to 2	400 to 800 feet.
Purcell, Ind. T.	11	12	1	¼ mile.
Lexington, Okla.	1	15	1	¼ mile.
Pecan, Okla.	11	‡	1½	¼ mile.
Buckhead, Okla.	2	12 to 15	2½	
Lakeview, Okla.	4	10	2	60 yards.
Corner, Okla.	24	30	1	40 yards.
Tyrola, Ind. T.	9	20	½	100 yards.
Francis, Ind. T.	9	20	¾	½ mile.
Calvin, Ind. T.	30	20	¾	¼ mile.
Garner, Ind. T.	32	§	1	

*12-foot rise. † 4½-foot rise. ‡ 5½ feet higher than ever known before. § 3-foot rise.

A PROPOSED INTERNATIONAL CONTEST OF WEATHER FORECASTERS.

We think that all sensible men will agree with the sentiments expressed in the following letter.—*C. A.*

WASHINGTON, D. C., *January 7, 1905.*

Mr. FERNAND JACOBS,
President, Société d'Astronomie, Brussels, Belgium.

DEAR SIR: I have the honor to acknowledge the receipt of your letter of the 14th of December, informing me that the Belgian Society of Astronomy has decided to organize an international contest of weather forecasters, to be held at Liege, September, 1905, during the session of a congress of meteorologists, and you further invite me to become one of the judges in that contest. If your action in the matter had not extended beyond this invitation, I should have simply declined it. But you have sent me a printed circular, stating in detail the terms under which the competition is to be carried out, and mentioning the individual names of those composing your jury, among which you have included my own name without my authority. I desire to protest against this action in the most emphatic manner possible, and shall communicate my protest to all of those distinguished gentlemen whom you have made my colleagues. It is not impossible that you have also printed their names without their personal permission, and that many of them will agree with me in my opinion of your action and of the inexpediency of any such public competition for prizes in forecasting.

It is probably not unknown to you that in America, as in Europe, there are numerous persons who derive profit from the sale of almanacs and newspaper forecasts, to the great disgrace of meteorology. This class of men, even though they fail to win the offered prize, will draw great profit from such a public competition and official scientific recognition; I protest against allowing them any chance of receiving such favorable public recognition at the hands of scientific men.

Meteorological science, and especially the art of forecasting, can not be furthered by such public tests and competitions as those you would encourage, and you must not expect me to serve as a member of your jury. Up to the present time the official forecasts published by European and American nations have been based on the daily weather maps, and made in accordance with all the knowledge that is embodied in what we call the science of meteorology. This knowledge is public property; the methods of forecasting have frequently been explained. Forecast students are accepted in every government office and encouraged to become thoroughly acquainted with the methods used therein. A competitive examination between such students seeking an appointment to office or a promotion would be eminently proper, but there is apparently no occasion to institute such a competition at Liege.

The phraseology of the forecasts differs in diffent countries in accordance with the needs of the people, and some attempt much more detailed forecasts than others. In no case, so far as I know, do the forecasts extend more than two days in advance, except for the seasonal forecasts in India. All such work is a legitimate application of science, and the whole meteorogical world is cooperating in efforts to improve it. It is not advisable to set these scientific men and government officials into public competition or rivalry with one another. Who would think of doing this in the matter of astronomical ephemerides or predictions of the places of the sun, moon, or planets?

The last article of your projet provides that amateurs may compete for the prize for long-range forecasts of the details of the weather during the month of September, 1905. But there is no rational or scientific basis for such long-range forecasts, and therefore the planetary astrologers or any one who guesses what September will be may come into the competition and receive a diploma of merit if by accident he makes a partially satisfactory forecast for the month. But such a single success can have no weight whatever in establishing the merit of any system. As before said, the competition itself can have no value to the scientific world, but will be taken advantage of by the popular charlatans and imposters of Europe and America.

Your proposed competition is directly contrary to the expressed opinion of some of the best European meteorologists, and I may especially refer you to the accompanying letter of Prof. J. N. Pernter, reprinted from the MONTHLY WEATHER REVIEW for May, 1904. You may be interested also in reading the enclosed pages from the advance proof of my Annual Report, in which I have referred to long-range forecasts.

Regretting that I can not encourage your public competition, but with the best wishes for the prosperity of the Belgian Astromical Society, I am,

Very respectfully,
(Signed) WILLIS L. MOORE,
Chief U. S. Weather Bureau.

CORRIGENDA.

MONTHLY WEATHER REVIEW for August, 1904, p. 372, column 2, line 10, "involve" read "evolve."

MONTHLY WEATHER REVIEW for October, 1904, p. 458, column 2, Table 1, number of days with thunderstorms in May, 1895, for "6" read "5"; p. 459, column 1, Table 4, average duration of thunderstorms in November, 1890, for "...." read "0"; p. 465, column 1, line 11, for "Helmholz" read "Helmholtz," line 16, for "Neuchoff" read "Neuhoff," line 18, for "Eckholm" read "Ekholm."

THE WEATHER OF THE MONTH.

By Mr. WM. B. STOCKMAN, Chief, Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart VIII and the average values and departures from normal are shown in Tables I and VI.

The mean barometer was highest over the Plateau regions, with the crest over western Wyoming. It was lowest over eastern New England.

The mean barometer was above the normal in the west Gulf States, the Mississippi and Missouri valleys, slope and Plateau regions, the south Pacific region, except the extreme southwestern portion, and the middle Pacific region, except the extreme northwestern portion. In all other districts it was below the normal.

The greatest positive departures from the normal ranged from + .10 to + .18 inch, and occurred in the middle and southern Plateau regions. The greatest negative departures ranged from — .10 to — .15 inch, and occurred over New England, and the extreme eastern portion of New York.

The mean pressure decreased from that of October, 1904, in New England, Middle Atlantic States, northern portion of the South Atlantic States, Ohio Valley and Tennessee, except the western portion, the Lake region, and the north Pacific district. In all the remaining districts it increased.

The maximum increase ranged from + .10 to + .16 inch, and occurred over the middle and southern slope and Plateau regions, the southern portion of the northern slope region, and southwestern North Dakota. The maximum decrease ranged from — .10 to — .17 inch, and occurred over New England, and the northeastern portion of the Middle Atlantic States.

TEMPERATURE OF THE AIR.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart V.

The mean temperature for the month was below the normal over the region east of the Appalachian Mountains; and above the normal in the remaining districts, except the central Rio Grande Valley.

The deficiency in temperature was not very marked, except in southern Florida where it ranged from —2° to —3°, and in New England, and the eastern portions of the Middle Atlantic States where it ranged from —2.5° to —6.7°, the greatest departure occurring over New England. Over the region west of the Appalachian Mountains the excess in temperature was, as a rule, very marked, the departures amounting to + 11° in western Minnesota, and North Dakota, and gradually decreasing to 2° eastward to Lake Huron, thence southwestward to central Texas, and westward over southeastern Arizona. An area in which the departures amounted to + 2°, or less, overlay central California.

The maximum temperature during any November since the establishment of the station was exceeded by 1° at Alpena, Mich.; 2° at Williston, N. Dak., and San Diego, Cal.; 4° at Marquette, Mich.; and 7° at Eureka, Cal.

The mean temperature for November, 1904, was higher than any other November mean by 1° at Baker City and Roseburg, Oreg.; 2° at Tatoosh Island, Wash., and Lewiston, Idaho; 3° at Point Reyes Light, Cal.; and 6° at North Head, Wash. At Northfield, Vt., the mean was 1° lower than any other recorded during November.

Maximum temperatures of 80°, or higher, occurred generally in the Peninsula of Florida, southwestern Arizona, and southern, northwestern, and the interior of central California.

Freezing temperatures occurred generally as far south as northern Florida, and the Gulf of Mexico, except along the littoral of the Carolinas, Georgia, Mississippi, Louisiana, and Texas.

Minimum temperatures above freezing were reported from the Pacific district, and southwestern Arizona.

The average temperatures for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	8	35 5	— 4.4	—24.0	— 2.2
Middle Atlantic	12	42.4	— 2.2	—20.6	— 1.9
South Atlantic	10	53.2	— 0.9	—11.7	— 1.1
Florida Peninsula *	8	64.7	— 1.9	+ 1.2	+ 0.1
East Gulf	9	55.9	— 0.1	— 2.4	— 0.2
West Gulf	7	58.3	+ 1.8	+ 8.7	+ 0.8
Ohio Valley and Tennessee	11	45.1	+ 0.4	—13.7	— 1.2
Lower Lake	8	39.6	+ 0.5	—22.1	— 2.0
Upper Lake	10	37.7	+ 4.2	—18.5	— 1.7
North Dakota *	8	36.0	+11.8	— 6.4	— 0.6
Upper Mississippi Valley	11	43.1	+ 5.7	—14.1	— 1.3
Missouri Valley	11	43.9	+ 7.0	+ 1.6	+ 0.1
Northern Slope	7	40.6	+ 8.0	+15.7	+ 1.4
Middle Slope	6	46.6	+ 5.3	+12.6	+ 1.1
Southern Slope *	6	52.5	+ 3.4	+15.5	+ 1.4
Southern Plateau *	13	48.4	+ 1.1	+ 3.5	+ 0.3
Middle Plateau *	8	39.5	+ 2.4	+ 5.5	+ 0.5
Northern Plateau *	12	43.2	+ 5.5	+26.5	+ 2.4
North Pacific	7	50.2	+ 4.9	+ 7.3	+ 0.7
Middle Pacific	5	56.2	+ 2.7	+ 8.3	+ 0.8
South Pacific	4	61.4	+ 3.8	+14.0	+ 1.3

* Regular Weather Bureau and selected voluntary stations.

In Canada.—Prof. R. F. Stupart says:

The temperature was below the average in Ontario from the Georgian Bay and Lake Huron eastward, and throughout Quebec and the Maritime Provinces; elsewhere it was above the average. The negative departures varied from average to 3° below in Ontario from the shores of Lake Superior to the eastern boundary, and from 2° to 4° below in Quebec and the Maritime Provinces. The positive departures were excessive, ranging from 4° on the eastern shores of Lake Superior to 13° and 14° in Manitoba, attaining as much as 15° and 16° in the western parts of Saskatchewan and Assiniboia, and then gradually diminishing to 6° on the British Columbia coast and over Vancouver Island.

PRECIPITATION.

The distribution of total monthly precipitation is shown on Chart III.

The precipitation was above the normal in central and western North Carolina, northeastern Georgia, central and southern Florida, northwestern Oregon, and western Washington; and below the normal in all the remaining districts.

The excess in precipitation was about 3 inches in central North Carolina; 2 to 4 inches in extreme southern Florida; and 2 to 5.8 inches in northwestern Washington. Over the region from eastern Texas and southern Louisiana northeastward to the St. Lawrence Valley and the New England coast the deficiency ranged from —2.0 to —4.1 inches, the greatest deficiency occurring in the lower Ohio Valley, Arkansas, northern Louisiana, and northeastern Texas.

By geographic districts the precipitation was above the normal in the Florida Peninsula, and the north Pacific district; and below the normal in all other districts.

The least precipitation during any November since the compilation of State records as a whole, was reported from Illinois, Idaho, Iowa, Wisconsin, and Pennsylvania.

Practically no precipitation occurred during the first fourteen days of the month in Montana; and after the 10th in Nebraska and Iowa, and after the 11th in Kansas, Colorado, Missouri, and Illinois.

Fifty-five stations in Utah reported no precipitation during the month, and ten others but a trace; Wyoming six without precipitation, and eight with but a trace; North Dakota four without and twelve but a trace; Idaho seven but a trace; Iowa one without and seven but a trace; Arkansas four without; and Indiana three with but a trace. In Kentucky the drought was general.

Well defined periods without precipitation occurred in the South Atlantic States from the 6th to the 11th, inclusive; 14th to 21st, inclusive; and 24th to 29th, inclusive; in the Florida Peninsula, on and after the 23d; in the east Gulf States 5th to 11th, inclusive, 14th to 20th, inclusive, and 23d to 28th, inclusive; in the west Gulf States 4th to 18th, inclusive, and 22d to 28th, inclusive; in the Ohio Valley and Tennessee 14th to 19th, inclusive, with scattered rains on and after the 23d. Light and scattered precipitation only occurred in the lower Lake region from the 6th to the 19th, inclusive. Measurable precipitation occurred on but five days in North Dakota; six in the upper Mississippi Valley; on practically but two in the Missouri Valley; three in the middle slope; five in the southern slope; three in the southern Plateau; and scattered on but three days in the middle Plateau and south Pacific regions.

The southern limit of snow extended to the northern portion of the South Atlantic and northeastern portion of the east Gulf States, central Mississippi Valley, northwestern Arkansas, northern Texas, south-central New Mexico, and westward to the Rocky Mountains.

HAIL.

The following are the dates on which hail fell in the respective States:

Arkansas, 11. California, 15, 18, 27. Connecticut, 6, 13. Delaware, 13. Idaho, 15, 28. Indiana, 10, 13. Maine, 5, 14. Massachusetts, 13, 30. Michigan, 13, 29. Missouri, 9. New Jersey, 13. New Mexico, 3, 4. New York, 5-7, 9, 13, 14, 19, 30. Ohio, 26. Oregon, 13, 15-17, 26, 27. Pennsylvania, 5, 29. Rhode Island, 13. South Carolina, 22. Texas, 4, 10, 11. Vermont, 28. Washington, 3, 30. Wyoming, 27.

SLEET.

The following are the dates on which sleet fell in the respective States:

Arkansas, 10, 12. Connecticut, 6, 11, 13. Delaware, 13. Illinois, 10. Indiana, 13, 25. Iowa, 9, 10, 28. Kansas, 9. Maine, 14, 24, 29. Maryland, 13. Massachusetts, 13, 14, 29. Michigan, 5, 13, 25. Minnesota, 9. Montana, 18, 20, 28. Nebraska, 8, 9, 29. New Hampshire, 23. New Jersey, 13. New Mexico, 10. New York, 5-7, 9, 13, 14, 20, 21, 24. North Carolina, 13. North Dakota, 9, 23. Ohio, 5, 6, 10, 13, 25. Oklahoma, 10, 11. Pennsylvania, 9, 13. Rhode Island, 9, 11, 13. South Carolina, 13. South Dakota, 9. Tennessee, 12. Texas, 12, 20. Vermont, 21, 28, 30. Washington, 20. West Virginia, 6, 8. Wisconsin, 28. Wyoming, 28.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	8	1.95	49	−2.0	−4.8
Middle Atlantic	12	1.60	52	−1.5	−9.3
South Atlantic	10	2.69	93	−0.2	−12.2
Florida Peninsula*	8	3.40	155	+1.2	+0.3
East Gulf	9	2.82	74	−1.0	−16.5
West Gulf	7	1.20	31	−2.7	−9.2
Ohio Valley and Tennessee	11	1.03	28	−2.6	−12.2
Lower Lake	8	0.30	10	−2.9	−1.7
Upper Lake	10	0.61	24	−1.9	−3.7
North Dakota*	8	0.11	14	−0.7	−0.4
Upper Mississippi Valley	11	0.16	8	−1.9	−2.2
Missouri Valley	11	0.17	13	−1.1	−0.9
Northern Slope	7	0.05	11	−0.4	−0.4
Middle Slope	6	0.06	6	−0.9	+1.5
Southern Slope*	6	0.13	8	−1.4	−1.8
Southern Plateau*	13	0.04	6	−0.6	−0.4
Middle Plateau*	8	0.01	1	−0.8	+2.0
Northern Plateau*	12	0.59	35	−1.1	−1.9
North Pacific	7	9.17	133	+2.3	−1.9
Middle Pacific	5	2.33	72	−0.9	+7.9
South Pacific	4	0.05	4	−1.3	+0.1

*Regular Weather Bureau and selected voluntary stations.

In Canada.—Professor Stupart says:

The precipitation was below the average in all portions of the Dominion, except in Prince Edward Island and Cape Breton, Charlottetown, in the former district, recording a positive departure of 1.6 inches, and Sidney, in the latter, 2.7 inches. The deficiency was very remarkable over Ontario and the greater portion of Quebec, particularly so in the more southern portions of Ontario, where the fall for the month was almost nil. Brantford reports a few snow flurries only, and Toronto, with 0.11 of an inch, registers the driest November on record, the next driest being 1894, with 0.61 of an inch. Montreal and Quebec were each over two and a quarter inches below the average amount, and Father Point half an inch below. In Manitoba and the Territories the precipitation, which was chiefly snow, was also extremely light. British Columbia, likewise, was very deficient in precipitation, Cariboo recording two and a quarter inches less than the average amount, and Victoria more than an inch and a half.

At the close of the month a light covering of snow was reported on the ground over the greater portion of the Northwest Territories and Manitoba, as well as in many parts of Quebec. In Ontario, along the shores of Lake Superior, the ground was covered to a depth of from three to five inches, and in the Georgian Bay region and locally elsewhere from three to nine inches. In the neighborhood of Collingwood, however, the depth is reported to be as much as eighteen inches. Northern New Brunswick was also covered to a depth of several inches.

HUMIDITY.

The averages by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	74	−4	Missouri Valley	61	−10
Middle Atlantic	73	−2	Northern Slope	62	−5
South Atlantic	72	−6	Middle Slope	56	−6
Florida Peninsula	79	−1	Southern Slope	60	−2
East Gulf	72	−4	Southern Plateau	40	−3
West Gulf	70	−4	Middle Plateau	51	−3
Ohio Valley and Tennessee	69	−4	Northern Plateau	62	−10
Lower Lake	73	−4	North Pacific	85	0
Upper Lake	76	−4	Middle Pacific	79	+4
North Dakota	70	−9	South Pacific	64	−3
Upper Mississippi Valley	71	−3			

The relative humidity was normal in the north Pacific region; above normal in the middle Pacific region; and below normal in all other districts.

CLEAR SKY AND CLOUDINESS.

Average cloudiness obtained in New England and the Middle Atlantic States. In the Florida Peninsula, east Gulf States, and southern slope and Pacific regions, it was above the average; and below the average in the remaining districts.

The distribution of clear sky is graphically shown on Chart IV, and the numerical values of average daylight cloudiness, both for individual stations and by geographic districts, appear in Table I.

The average for the various districts, with departures from the normal, are shown in the following table:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.6	0.0	Missouri Valley	3.4	−1.5
Middle Atlantic	5.2	0.0	Northern Slope	4.3	−0.3
South Atlantic	4.3	−0.2	Middle Slope	3.2	−0.4
Florida Peninsula	5.2	+0.6	Southern Slope	4.0	+0.8
East Gulf	4.6	+0.1	Southern Plateau	1.6	−0.7
West Gulf	3.9	−0.7	Middle Plateau	3.2	−0.4
Ohio Valley and Tennessee	5.0	−0.7	Northern Plateau	5.7	−0.3
Lower Lake	6.5	−0.7	North Pacific	8.4	+1.4
Upper Lake	6.2	−0.8	Middle Pacific	5.6	+1.8
North Dakota	3.8	−1.5	South Pacific	3.0	+0.1
Upper Mississippi Valley	4.0	−1.3			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Block Island, R. I.	13	74	ne.	North Head, Wash.	5	63	se.
Do	14	59	nw.	Do	7	65	se.
Buffalo, N. Y.	12	57	sw.	Do	12	50	se.
Cape Henry, Va.	13	62	nw.	Do	15	86	se.
Cheyenne, Wyo.	28	51	nw.	Do	16	89	se.
Cleveland, Ohio	13	60	n.	Do	17	56	s.
Do	24	52	nw.	Do	19	84	se.
Do	26	52	nw.	Do	20	59	s.
Eastport, Me.	13	52	ne.	Do	21	74	se.
Do	14	60	ne.	Do	27	74	se.
Hatteras, N. C.	13	68	sw.	Do	30	62	s.
Do	14	54	w.	Point Reyes Light, Cal.	14	60	se.
Havre, Mont.	22	58	sw.	Do	15	53	se.
Mount Tamalpais, Cal.	1	56	s.	Syracuse, N. Y.	29	50	s.
Do	30	53	nw.	Tatoosh Island, Wash.	2	52	sw.
Mount Weather, Va.	14	66	nw.	Do	4	52	w.
Do	21	50	nw.	Do	9	56	e.
Do	24	56	nw.	Do	15	56	sw.
Do	25	60	nw.	Do	17	52	sw.
Nantucket, Mass.	13	60	ne.	Do	19	80	s.
New Haven, Conn	13	50	ne.	Do	20	52	sw.
New York, N. Y.	14	60	nw.	Do	21	78	s.
Do	21	52	nw.	Do	23	52	e.
North Head, Wash	1	57	se.	Do	24	60	e.
Do	2	52	se.	Do	27	66	s.
Do	4	62	se.	Do	30	56	s.

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 159 thunderstorms were received during the current month as against 889 in 1903 and 1227 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 3d, 16th, 27th, 16; 20th, 22d, 13.

Reports were most numerous from: Oregon, 35; Florida, 23; Texas, 18.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the dates of full moon, viz, November 18 to 26, inclusive.

In Canada: Thunderstorms were reported from Rockliffe, 20; Port Stanley, 19; Parry Sound, 19.

Auroras were reported from Quebec, 4; Port Arthur, 16; Minnedosa, 17; Qu'Appelle, 16; Swift Current, 15, 16; Edmonton, 2, 4, 15, 16; Battleford, 16.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. WM. B. STOCKMAN, Chief, Division of Meteorological Records.

For description of tables and charts see page 475 of REVIEW for October, 1904.

TABLE I.—*Climatological data for Weather Bureau stations, November, 1904.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Direction.	Date.					
New England.							35.5	— 4.4											74	1.93	— 2.0						5.6				
Eastport	76	69	82	29.77	29.86	— .15	33.2	— 3.5	50	20	39	10	29	27	36	30	26	75	1.54	— 2.7	11	9,821	nw.	60	ne.	14	7	6	17	7.2	1.9
Portland, Me.	103	81	117	29.79	29.92	— .12	33.5	— 4.5	55	20	41	11	29	26	26	30	25	74	1.93	— 2.1	6	6,603	nw.	41	n.	14	16	8	6	4.3	14.1
Concord	288	70	79	29.61	29.95	— .11	32.2	— 5.1	55	3	41	6	29	23	39	....	....	....	1.58	— 1.8	5	3,607	nw.	36	nw.	14	10	11	9	5.3	7.1
Northfield	876	16	60	28.99	29.97	— .08	26.2	— 6.7	56	3	36	— 4	29	16	33	23	20	79	0.56	— 2.6	7	5,286	s.	34	nw.	14	10	8	12	5.9	7.1
Boston	125	115	181	29.79	29.93	— .12	38.2	— 2.4	60	20	46	15	29	31	34	33	27	67	1.70	— 2.9	5	7,778	nw.	41	ne.	13	13	5	12	5.2	T.
Nantucket	12	14	90	29.90	29.91	— .14	40.6	— 4.1	57	20	46	18	29	35	35	38	35	82	3.29	— 0.3	8	11,394	nw.	60	ne.	13	4	11	15	6.9	8.1
Block Island	26	11	46	29.91	29.94	— .12	40.6	— 4.3	56	4	46	20	29	35	32	37	32	71	2.11	— 2.1	8	14,722	nw.	74	ne.	13	10	6	14	5.7	1.0
Narragansett	....	9	38	....	....	....	36.9	— 6.1	58	4	46	9	29	28	42	....	....	....	2.88	— 1.3	7	....	w.	....	....	....	15	1	14	....	3.0
New Haven	106	116	154	29.84	29.96	— .11	38.4	— 2.7	60	4	46	15	29	30	35	34	29	72	1.95	— 2.0	7	6,477	nw.	50	ne.	13	11	11	8	4.7	0.5
Mid. Atlantic States.							42.4	— 2.2											73	1.60	— 1.5						5.3				
Albany	97	102	115	29.87	29.98	— .10	34.8	— 4.4	57	3	42	13	29	28	29	31	27	79	0.64	— 2.3	2	5,201	s.	33	s.	29	9	8	13	5.8	6.2
Binghamton	875	79	90	29.04	29.99	— .10	34.8	— 3.2	59	20	43	12	28	27	30	....	....	....	0.49	— 1.8	8	4,281	e.	28	nw.	13	8	9	13	6.4	4.7
New York	314	108	350	29.63	29.98	— .11	41.4	— 2.0	59	1	47	21	28	36	26	38	34	76	2.62	— 1.2	9	10,075	nw.	60	nw.	14	8	14	8	5.7	0.5
Harrisburg	374	94	104	29.62	30.03	— .08	41.0	— 1.4	63	1	48	21	28	34	30	36	30	70	0.54	— 2.3	4	5,372	w.	36	w.	27	10	9	11	5.2	0.4
Philadelphia	117	116	184	29.88	30.01	— .09	43.2	— 0.7	64	1	50	25	28	37	28	38	32	67	2.55	— 0.7	8	7,673	nw.	42	n.	13	12	7	11	5.4	0.9
Scranton	805	111	119	29.12	30.01	— .08	37.4	.....	58	3	45	16	28	30	26	34	30	75	1.51	.....	9	4,874	sw.	29	nw.	14	3	11	16	7.4	6.8
Atlantic City	52	39	48	29.94	30.00	— .10	42.2	— 2.5	65	1	50	19	28	34	25	39	35	76	2.29	— 1.2	6	5,984	nw.	43	n.	13	10	9	11	5.2	1.2
Cape May	17	48	52	30.01	30.03	— .07	44.0	— 2.6	62	1	50	26	28	38	27	40	....	....	1.73	— 1.6	9	6,992	nw.	46	nw.	13	8	17	5	4.9	T.
Baltimore	123	69	117	29.88	30.01	— .10	43.8	— 1.6	66	1	51	23	28	36	29	38	33	69	1.87	— 1.2	8	5,210	nw.	36	w.	13	10	6	14	5.8	3.0
Washington	112	59	76	29.91	30.04	— .08	43.1	— 1.4	68	1	52	25	28	34	38	38	33	72	2.20	— 0.6	8	4,792	w.	32	nw.	14	10	11	9	5.1	4.0
Cape Henry	18	11	58	30.00	30.02	— .08	48.2	— 3.7	67	20	54	31	13	42	32	....	....	....	1.02	— 2.6	5	10,058	s.	62	nw.	13	15	9	6	4.3	T.
Lynchburg	681	83	88	29.30	30.06	— .07	44.5	— 1.8	72	1	56	22	29	33	44	38	32	70	0.98	— 2.0	5	2,914	nw.	29	nw.	14	15	11	4	4.0	T.
Mount Weather	1,725	10	57	28.17	30.02	.....	39.6	.....	63	20	46	18	27	33	29	35	30	72	0.83	.....	4	13,339	nw.	66	nw.	14	11	12	7	4.5	4.0
Norfolk	91	102	111	29.94	30.04	— .07	48.6	— 1.7	69	3	56	30	28	41	32	44	41	81	1.96	— 1.1	3	5,783	nw.	38	n.	13	13	11	6	4.4	T.
Richmond	144	82	90	29.90	30.06	— .06	46.2	.....	67	20	56	27	28	37	32	....	....	....	2.55	.....	4	3,259	nw.	23	sw.	29	14	10	6	4.4	1.8
Wytheville	2,293	40	47	27.65	30.09	— .04	41.8	— 1.3	66	1	52	21	15	32	37	34	29	71	1.88	— 0.3	8	4,321	w.	27	w.	13	11	11	8	4.7	1.2
S. Atlantic States.							53.2	— 0.9											72	2.69	— 0.2						4.3				
Asheville	2,255	53	75	27.70	30.07	— .07	44.0	— 2.4	65	1	54	21	15	34	35	37	32	69	3.10	+ 0.4	8	5,174	nw.	32	nw.	13	13	10	7	4.4	4.6
Charlotte	773	68	76	29.22	30.08	— .05	50.0	+ 0.1	69	5	59	29	15	41	28	42	36	66	3.01	0.0	7	4,377	ne.	35	w.	13	15	6	9	4.3	T.
Hatteras	11	12	47	30.02	30.03	— .08	53.9	— 1.7	72	10	60	38	28	48	28	49	46	79	2.37	— 2.8	7	9,816	n.	68	sw.	13	18	6	6	3.7	
Raleigh	376	71	79	29.64	30.06	— .07	49.2	— 0.4	70	20	58	29	15	40	30	42	36	67	5.13	+ 3.0	4	4,159	nw.	26	nw.	14	14	10	6	4.3	T.
Wilmington	78	82	90	29.96	30.04	— .08	52.7	— 1.9	73	22	62	31	28	43	33	46	42	75	1.64	— 0.8	7	4,981	w.	38	w.	13	17	7	6	3.7	
Charleston	48	14	92	30.02	30.07	— .05	57.2	— 0.4	75	21	65	38	14	50	24	50	46	75	1.85	— 1.2	6	6,845	n.	45	w.	13	10	13	7	4.6	
Columbia, S. C.	351	167	175	29.68	30.07	— .05	53.6	— 1.2	73	21	63	33	28	45	27	45	39	65	2.11	— 0.2	8	6,780	sw.	40	sw.	13	13	10	7	5.0	
Augusta	180	89	97	29.88	30.08	— .05	53.0	— 0.4	73	21	64	30	15	42	35	46	41	74	2.21	— 0.8	8	3,832	nw.	39	w.	13	12	12	6	4.0	
Savannah	65	81	89	30.00	30.07	— .05	57.8	0.0	75	21	66	38	28	49	28	50	45	74	3.20	+ 0.9	8	5,124	n.	38	w.	13	12	10	8	4.4	
Jacksonville	43	101	129	30.00	30.05	— .05	60.6	— 0.8	80	3	68	40	28	53	26	54	50	78	2.26	— 0.3	6	5,715	sw.	40	w.	13	14	8	8	4.5	
Florida Peninsula.							68.4	— 2.7											79	4.13	+ 1.8						5.2				
Jupiter	28	10	48	30.01	30.04	— .01	68.8	— 3.0	82	3	75	50	14	62	22	63	60	80	3.68	+ 0.8	13	7,490	nw.	34	w.	12	6	18	6	5.3	
Key West	22	10	53	30.01	30.03	+ .01	71.8	— 2.4	83	2	76	63	7	68	15	66	63	78	6.22	+ 4.0	12	7,573	ne.	43	nw.	13	13	9	8	5.0	
Tampa	34	79	96	30.02	30.06	— .02	64.7	— 2.7	79	1	72	45	28	57	27	57	54	78	2.48	+ 0.7	6	5,172	ne.	29	w.	13	10	9	11	5.5	
East Gulf States.							55.9	— 0.1											72	2.82	— 1.0						4.6				
Atlanta	1,174	190	216	28.84	30.09	— .04	51.6	— 0.2	71	19	60	31	14	44	24	45	39	71	2.35	— 1.2	9	8,991	nw.	38	nw.	24	11	13	6	4.5	T.
Macon	370	93	99	29.69	30.09	— .04	53.4	.....	72	1	64	30	15	43	34	....	....	....	2.26	.....	8	4,106	nw.	30	nw.	13	11	7	12	5.4	
Pensacola	56	79	96	30.04	30.10	— .01	59.4	+ 0.2	74	8	67	40	28	52	24	....	....	....	3.82	0.0	5	6,557	ne.	36	ne.	2	12	6	12	5.3	
Birmingham	700	136	143	29.34	30.11	— .01	52.9	— 1.4	71	19	62	31	27	43	29	....	....	....	3.54	— 0.3	7	4,665	nw.	25	e.	3	17	5	8	4.1	T.
Mobile	57	88	96	30.04	30.10	— .01	57.8	— 0.1	75	9	67	36	15	49	30	51	47	74	2.56	— 1.3	4	4,440	n.	18	nw.	11	13	7	10	4.5	
Montgomery	223	100	112	29.86	30.10	— .02	55.4	+ 0.2	76	21	66	32	15	45	34	48	44	75	2.59	— 0.8	7	4,060	w.	23	w.	13	14	7	9	4.3	
Meridian	375	84	93	29.71	30.11	— .01	52.6	— 0.8	74	19	64	27	15	41	39	....	....	....	2.84	— 0.2	6	3,130	ne.	23	e.	2	15	6	9	4.5	
Vicksburg	247	62	74	29.83	30.10	— .02	56.6	+ 1.2	77	1	66	36	13	47	28	49	44	71	2.95	— 1.9	7	4,180	n.	19	nw.	12	15	8	7	3.8	
New Orleans	51	88	121	30.04	30.10	.00	60.8	+ 0.1	78	20	69	39	13	53	27	53	48	71	1.90	— 2.3	5	5,948	ne.	36	ne.	2	13	9	8	4.8	
West Gulf States.							58.3	+ 1.8											70	1.20	— 2.7						3.9				
Shreveport	249	77	84	29.86	30.14	+ .03	56.6	+ 2.0	79	9	68	32	13	46	35	47	40	64	0.93	— 3.8	6	3,851	nw.	26	nw.	9	19	6	5	3.4	
Fort Smith	457	79	94	29.62	30.11	.00	53.2	+ 3.9	77	18	65	28	13	41	37	44	36	62	0.26	— 3.4	3	4,902	e.	42	nw.	9	16	9	5	3.4	
Little Rock	357	93	100	29.75	30.13	+ .01	53.2	+ 2.4	75	18	63	29	13	44	32	45	37	61	1.35	— 3.9	4	4,403	nw.	27	s.	28	15	4	11	4.7	T.
Corpus Christi	20	48	53	30.11	30.13	+ .06	63.4	+ 0.4	80	29	70	37	12	56	36	58	55	81	0.84	— 2.2	10	4,898	n.	26	n.	10	9	12	9	5.2	
Fort Worth	670	106	114	29.42	30.14	+ .04	56.6	.....	82	23	68	27	12	45	36	....	....	....	0.02	.....	1	6,115	nw.	32	sw.	28	21	6	3	3.0	
Galveston	54	106	112	30.07	30.13	+ .04	62.5	+ 0.1	78	9	68	38	12	57	19	58	54	80	4.14	— 0.3	8	70, 93	n.	32	n.	10	16	9	5	3.5	
Palestine	510	73	79	29.60	30.14	+ .03	58.4	+ 2.2	79	23	69	31	12	48	34	50	45	72	0.67	— 3.8	4	4,378	ne.	25	sw.	28	14	10	6	4.1	
San Antonio	701	80	91	29.39	30.13	+ .05	60.5	+ 1.5	82	9	72	29	12	49	37	52	46	67	0.24	— 1.8	4	4,153	n.	30	n.	10	16	9	5	3.6	
Taylor	583	55	63	29.52	30.13	+ .05	58.6	.....	81	9	70	28	12	47	37	....	....	....	0.46	.....	2	4,833	n.	33	s.	28	15	6	9	4.5	
Ohio Val. and Tenn.							45.1	+ 0.4											69	1.03	— 2.6						5.0				
Chattanooga	762	106	112	29.30	30.13	— .01	49.4	— 0.5	69	1	59	28	28	40	34	42	37	70	3.09	— 0.7	10	4,101	nw.	28	w.	13	17	5	8	4.3	
Knoxville	1,004	35	88	29.03	30.10	— .03	46.6	0.0	68	1	57	26	27	37	35	41	37	79	3.43	— 0.4	9	4,256	nw.	30	w.	13	11	11	8	4.9	2.0
Memphis	397	146	154	29.71	30.14	+ .02	52.6	+ 2.7	73	1	60	33	13	45	26	44	37	62	1.46	— 3.2	6	5,757	nw.	28	s.	28	19	1	10	3.9	
Nashville	546	122	134	29.54	30.13	+ .01	48.8	+ 0.8	71	19	58	26	28	40	36	42	36	70	1.66	— 2.2	7	3,866	nw.	27	nw.	13	19	1	10	3.8	
Lexington	989	75	102	29.02	30.11	— .01	44.2	— 0.3	67	19	53	20	27	36	25	....	....	....	0.53	— 3.2	3	6,631	nw.	36	s.	29	11	11	8	4.8	0.3
Louisville	525	114	136	29.53	30.12	.00	46.2	+ 0.9	72	19	56	25	27	37	33	39	33	66	0.25	— 3.8	2	5,108	n.	29	nw.	13	13	10	7	4.5	T.
Evansville	431	72	82	29.63	30.11	— .01	46.6	.....	71	19	56	27	27	38	28	....	....	....	0.20	.....	3	4,192	nw.	31	s.	28	13	12	5	3.6	
Indianapolis	822	154	164	29.19	30.09	— .01	43.1	+ 2.2	67	19	52	19	27	35	27	37	31	67	0.11	— 3.7	1	6,615	nw.	38	sw.	29	10	13	7	4.7	T.
Cincinnati	628	152	160	29.40	30.10	— .02	44.4	+ 0.5	68	3	54	24	27	35	33	38	30	63	0.34	— 3.0	1	4,553	nw.	24	nw.	13	10	14	6	4.8	T.
Columbus	824	173	190	29.17	30.07	— .04	42.4	+ 1.2	68	3	51	21	27	34	32	36	31	71	0.18	— 3.1	4	7,705	sw.	38	sw.	29	9	11	10	5.6	0.2
Pittsburg	842	336	352	29.12	30.04	— .06	43.8	+ 1.0	68	2	53	20	28	34	28	37	30	64	0.22	— 2.3	7	7,138	nw.	36	sw.	29	5	11	14	6.5	0.1
Parkersburg	638	77	84	29.40	30.10	— .02	42.1	— 1.9	66	20	52	23	12	32	38	36	31	72	0.11	— 3.0	1	4,123	nw.	28	nw.	26	5	9	16	7.2	T.
Elkins	1,940	41	50	27.98	30.07	— .05	37.2	— 2.2	66	3	49	13	15	25	40	31	28	78	1.02	— 2.9	7	2,680	nw.	18	w.	27	7	4	19	6.7	5.7
Lower Lake Region.							39.6	+ 0.5											73	0.30	— 2.9						6.5				
Buffalo	767	178	206	29.14	29.99	— .06	38.5	+ 0.3	59	19	45	17	28	32	25	34	30	76	0.51	— 3.0	8	11,502	w.	57	sw.	12	1	14	15	7.4	2.3
Oswego	335	76	91	29.59	29.97	— .08	36.3	— 2.2	60	3	43	8	28	30	32	33	29	75	0.45	— 2.9	8	8,654	nw.	48	n.	13	6	6	18	7.1	2.5
Rochester	523	81	102	29.41	29.99	— .06	37.6	+ 0.2	64	3	44	14	28	31	29	33	29	74	0.33	— 2.5	7	6,192	sw.	37	sw.	12	5	10	15	7.1	2.1
Syracuse	597	97	113	29.32	29.97	— .09	35.6	.....	62	20	42	11	28	29	28	....	....	....	0.32	.....	7	8,175	nw.	50	s.	29	6	7	17	6.9	2.0
Erie	713	92	102	29.22	30.00	— .06	40.4	— 0.6	66	2	46	21	28	34	24	36	31	72	0.40	— 3.8	10	9,144	sw.	39	s.	29	7	7	16	6.5	2.8
Cleveland	762	190	201	29.19	30.03	— .04	40.8	+ 1.1	63	2	47	23	28	34	25	37	32	73	0.41	— 2.5	11	12,598	nw.	60	n.	13	6	8	16	6.4	0.3
Sandusky	629	62	70	29.35	30.04	— .04	41.7	+ 1.3	65	1	48	21	28	35	26	....	....	....	0.09	— 3.0	1	6,867	sw.	37	n.	13	6	14	10	5.7	T.
Toledo	628	120	127	29.35	30.05	— .02	41.4	+ 2.2	68	3	49	22	28	34	26	35	29	68	0.04	— 2.8	2	7,459	sw.	36	sw.	29	7	12	11	5.5	0.2
Detroit	730	153	193	29.22	30.03	— .03	40.1	+ 2.0	68	3	47	16	28	33	25	35	31	74	0.19	— 2.5	4	8,351	sw.	36	n.	13	8	13	9	5.5	0.8
Upper Lake Region.							37.7	+ 4.2											76	0.61	— 1.9						6.2				
Alpena	609	63	80	29.32	30.00	— .01	35.8	+ 3.0	68	2	42	12	28	29	29	33	29	81	0.89	— 1.9	10	7,527	nw.	37	se.	28	7	12	11	6.5	6.7
Escanaba	612	40	48	29.34	30.02	— .01	35.4	+ 4.2	58	2	42	7	30	29	24	32	28	78	0.55	— 1.8	6	5,771	n.	27	nw.	26	8	10	12	5.9	5.0
Grand Rapids	707	127	165	29.25	30.04	.00	40.6	+ 3.0	68	3	48	21	27	33	28	35	31	76	0.06	— 3.4	3	7,871	sw.	40	sw.	12	7	10	13	5.9	0.6
Houghton	668	66	74	29.26	30.00	— .02	36.4	.....	66	18	42	10	28	30	31	....	....	....	2.06	.....	10	5,185	nw.	28	nw.	11	4	7	19	7.5	18.0
Marquette	734	76	116	29.20	30.01	— .01	36.4	+ 5.0	73	3	42	12	28	31	40	33	28	75	1.68	— 1.0	11	8,518	nw.	43	sw.	21	4	8	18	7.1	17.4
Port Huron	638	70	120	29.33	30.04	— .01	37.5	+ 1.1	63	2	45	8	28	30	25	33	30	80	0.43	— 2.4	5	9,525	nw.	48	n.	13	8	12	10	5.7	2.7
Sault Ste. Marie	614	40	61	29.29	29.97	— .04	33.6	+ 3.3	59	2	40	6	27	28	19	30	27	80	1.52	— 1.0	9	6,581	nw.	38	nw.	12	6	10	14	6.5	13.1
Chicago	823	241	274	29.17	30.07	.00	42.8	+ 4.4	67	2	49	19	30	36	25	37	32	70	0.31	— 2.4	4	11,732	sw.	47	se.	28	10	14	6	5.4	T.
Milwaukee	681	124	142	29.31	30.06	+ .01	42.0	+ 6.8	69	1	49	15	30	35	23	36	30	69	0.11	— 1.9	3	8,389	w.	47	se.	28	8	9	13	5.9	T.
Green Bay	617	49	86	29.36	30.03	— .01	38.0	+ 5.9	66	3	45	9	30	31	27	33	29	74	0.34	— 1.7	5	7,652	sw.	36	ne.	9	9	6	15	5.9	0.3
Duluth	1,133	11	47	28.78	30.04	.00	34.5	+ 5.8	70	3	43	2	30	27	31	30	27	80	0.24	— 1.4	4	9,567	nw.	38	nw.	29	8	14	8	5.9	2.1

TABLE I.—*Climatological data for Weather Bureau stations, November, 1904*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.			Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
North Dakota.							35.5	+10.1									70	0.04	— 0.6									3.8	
Moorhead	935	8	57	29.04	30.09	+ .02	35.2	+11.0	70	2	47	4	30	24	39	29	26	80	0.08	0.8	3	5,831	nw.	35	nw.	28	17	9	4	3.1	0.4
Bismarck	1,674	16	29	28.28	30.12	+ .05	36.8	+10.9	73	2	50	3	30	24	44	28	22	65	0.03	0.6	1	5,907	nw.	42	nw.	28	18	8	4	3.5	T.
Williston	1,875	14	44	28.04	30.08	+ .02	34.6	+ 8.5	71	2	50	−9	30	19	46	27	20	64	0.01	0.5	1	5,502	sw.	38	nw.	28	11	10	9	4.9	T.
Upper Miss. Valley.							43.1	+ 5.7									71	0.16	1.9									4.0	
Minneapolis		102	208				38.6	+ 8.9	69	3	46	12	30	31	31				0.10	0.6	3	8,546	nw.	40	ne.	9	16	6	8		0.3
St. Paul	837	171	179	29.13	30.06	.00	38.8	+ 8.9	67	18	46	9	30	32	29	34	29	70	0.12	1.0	3	6,772	nw.	36	nw.	23	15	5	10	4.7	0.7
La Crosse	714	71	87	29.29	30.08	+ .01	40.0	+ 6.6	69	1	48	13	30	32	29				0.13	1.3	2	5,294	s.	27	ne.	9	13	6	11	5.4	T.
Madison	974	70	78	28.99	30.06		40.2		68	3	48	14	30	33	26	34	29	70	0.03	1.7	3	7,881	nw.	36	ne.	10	13	10	7	4.5	T.
Charles City	1,015	8	58	28.97	30.08		38.2		70	3	50	8	30	26	38	31	28	82	0.25	1.2	2	5,139	nw.	36	nw.	23	14	11	5	3.6	T.
Davenport	606	71	79	29.42	30.07	− .01	42.3	+ 5.5	71	19	52	14	30	33	31	36	31	72	0.18	1.9	2	4,557	nw.	31	w.	29	17	9	4	3.5	
Des Moines	861	84	99	29.18	30.13	+ .05	42.9	+ 6.5	71	18	55	13	30	31	36	36	30	69	0.06	1.6	1	4,913	sw.	27	sw.	19	18	6	6	4.0	T.
Dubuque	698	100	117	29.32	30.09	+ .02	41.1	+ 6.1	69	1	50	15	30	32	31	35	30	72	0.08	2.0	2	4,266	nw.	33	nw.	23	12	11	7	5.0	T.
Keokuk	614	63	78	29.42	30.09	.00	44.8	+ 6.0	73	19	55	16	30	35	32	37	33	73	0.21	1.9	2	4,543	nw.	34	nw.	29	22	4	4	2.4	
Cairo	356	87	93	29.74	30.13	+ .01	48.6	+ 2.4	71	19	58	30	13	40	30	42	36	70	0.15	4.1	2	4,977	n.	28	n.	13	11	8	11	5.0	
Springfield, Ill.	644	82	93	29.40	30.10	.00	44.2	+ 3.3	72	18	55	18	30	34	32	37	31	67	0.02	3.0	1	5,816	s.	28	w.	29	15	10	5	3.9	
Hannibal	534	75	109	29.53	30.12	+ .03	44.4	+ 4.2	73	19	56	18	30	33	38				0.26	1.8	2	5,418	sw.	32	sw.	19	18	7	5	3.1	
St. Louis	567	208	217	29.49	30.10	.00	48.2	+ 4.6	72	18	57	25	30	40	30	40	34	63	0.54	2.6	2	6,882	nw.	33	s.	28	17	9	4	3.3	
Missouri Valley.							43.9	+ 7.0									61	0.17	1.1									3.4	
Columbia, Mo.	784	11	84	29.26	30.11	+ .02	45.5	+ 2.5	75	18	58	19	14	33	37				0.28	2.0	2	4,766	w.	33	sw.	19	22	5	3	2.8	
Kansas City	963	78	95	29.10	30.16	+ .07	48.6	+ 7.9	74	19	58	24	12	39	30	40	33	62	0.19	2.0	2	4,773	nw.	34	sw.	19	20	7	3	2.7	T.
Springfield, Mo	1,324	98	104	28.70	30.13	+ .03	49.4	+ 5.9	73	18	59	27	26	40	32	40	37	60	0.22	2.9	3	6,341	nw.	38	sw.	28	22	1	7	3.1	T.
Topeka		85	89				47.0	+ 5.8	74	18	60	19	12	34	34				0.17	0.9	2	5,361	s.	30	sw.	19	17	10	3	3.2	0.1
Lincoln	1,189	75	84	28.82	30.12	+ .04	44.6	+ 6.5	73	6	57	18	30	32	37	36	29	63	0.28	0.4	2	5,996	s.	32	nw.	9	17	11	2	3.2	1.5
Omaha	1,105	115	121	28.91	30.12	+ .04	44.8	+ 8.2	70	18	55	21	30	35	31	37	28	58	0.10	1.0	2	5,284	nw.	36	nw.	29	15	10	5	3.8	0.3
Valentine	2,598	47	54	27.36	30.14	+ .06	40.6	+ 6.3	75	18	56	6	11	25	44	31	22	56	0.19	0.2	2	6,138	w.	39	nw.	29	13	13	4	3.7	0.7
Sioux City	1,135	96	164	28.86	30.10	+ .02	41.6	+ 7.3	70	1	54	15	30	30	36				0.05	0.8	2	8,016	nw.	43	nw.	29	19	8	3	3.1	T.
Pierre	1,572	43	50	28.43	30.13	+ .05	40.5	+ 8.6	77	2	54	9	11	26	45	31	24	60	0.14	0.3	3	3,161	nw.	17	nw.	28	12	8	10	4.7	T.
Huron	1,306	56	67	28.69	30.12	+ .04	38.2	+ 8.7	72	2	53	4	30	24	42	30	24	67	0.10	0.5	1	6,969	nw.	36	nw.	19	13	12	5	4.2	T.
Yankton	1,233	42	49	28.74	30.09	+ .01	42.2	+ 9.4	78	18	56	9	30	28	51				0.11	0.6	2	4,429	w.	30	nw.	19	17	8	5	3.4	0.5
Northern Slope.							40.6	+ 8.0									63	0.05	0.4									4.3	
Havre	2,505	11	44	27.37	30.05	+ .02	39.3	+ 9.4	64	3	54	8	10	25	48	33	28	70	T.	0.6	0	6,215	sw.	58	sw.	22	10	11	9	5.1	T.
Miles City	2,371	42	50	27.53	30.08	+ .01	40.8	+ 9.5	71	1	54	16	30	28	40	35	31	78	0.10	0.3	0	3,371	w.	34	nw.	28	17	11	2	3.4	
Helena	4,110	8	56	25.88	30.14	+ .04	41.0	+ 9.5	61	21	50	19	25	32	30	33	24	54	0.03	0.6	2	4,209	sw.	44	w.	21	8	11	11	5.6	
Kalispell	2,965	45	51	26.99	30.09	+ .02	38.8		57	2	47	20	19	30	29	34	30	76	0.26		5	3,105	w.	25	sw.	22	7	9	14	6.4	T.
Rapid City	3,234	46	50	26.67	30.10	+ .02	43.4	+ 8.5	68	22	57	18	11	30	37	34	26	61	0.19	0.2	2	5,338	nw.	42	nw.	9	20	6	4	3.1	0.3
Cheyenne	6,088	56	64	24.10	30.18	+ .11	40.7	+ 6.5	67	27	55	7	11	26	44	28	11	35	0.02	0.3	1	6,982	nw.	51	nw.	28	16	8	6	3.6	0.3
Lander	5,372	26	36	24.76	30.25	+ .15	36.0	+ 4.4	64	22	52	8	11	20	40	27	20	63	0.01	0.6	1	1,879	ne.	28	n.	28	12	16	2	4.0	0.1
Yellowstone Park	6,200	11	47	23.99	30.23	+ .12	36.4		58	4	48	14	19	25	34	27	18	52	0.18		4	5,749	sw.	32	sw.	20	9	16	5	5.2	1.6
North Platte	2,821	43	52	27.19	30.18	+ .10	43.3	+ 8.1	77	6	61	12	11	26	49	32	26	65	0.03	0.3	1	4,895	w.	37	nw.	9	20	9	1	2.7	0.2
Middle Slope.							46.6	+ 5.3									56	0.06	0.9									3.2	
Denver	5,291	79	151	24.83	30.17	+ .11	43.9	+ 5.9	73	27	60	10	11	28	47	32	20	45	0.04	0.6	2	5,643	s.	44	nw.	28	19	9	2	3.0	2.2
Pueblo	4,685	80	86	25.40	30.17	+ .12	42.3	+ 3.5	74	18	61	7	11	24	53	31	20	47	T.	0.3	0	3,764	nw.	38	n.	9	22	5	3	2.9	T.
Concordia	1,398	42	47	28.65	30.16	+ .08	45.7	+ 5.7	74	18	59	20	26	32	39	36	30	66	0.20	0.6	2	3,395	s.	20	nw.	9	19	7	4	3.2	1.6
Dodge	2,509	44	54	27.52	30.18	+ .11	46.0	+ 5.8	74	18	61	12	11	31	45	35	28	63	0.04	0.4	2	5,643	nw.	36	nw.	9	17	7	6	3.8	0.4
Wichita	1,358	78	86	28.70	30.16	+ .08	49.2	+ 6.4	74	18	62	17	12	36	35	39	31	59	0.07	0.8	3	5,328	n.	28	nw.	9	19	8	3	3.5	0.2
Oklahoma	1,214	79	86	28.83	30.13	+ .05	52.6	+ 4.7	75	7	65	17	12	41	35	43	35	58	0.04	2.5	1	6,983	nw.	36	nw.	9	22	3	5	3.1	0.4
Southern Slope.							51.4	+ 3.2									60	0.30	0.8									4.0	
Abilene	1,738	45	54	28.32	30.15	+ .08	54.8	+ 2.8	80	23	66	25	12	43	37	46	39	63	0.40	1.0	2	4,161	s.	25	n.	9	17	7	6	4.2	
Amarillo	3,676	10	49	26.36	30.15	+ .10	48.0	+ 3.5	75	18	62	21	12	34	47	37	28	57	0.20	0.5	4	7,259	nw.	50	n.	9	17	10	3	3.9	0.5
Southern Plateau.							51.0	+ 1.6									40	0.04	0.6									1.6	
El Paso	3,762	10	110	26.32	30.16	+ .16	49.7	− 1.8	75	19	65	24	12	34	39	39	30	58	0.01	0.5	1	4,045	nw.	35	ne.	4	23	7	0	1.3	
Santa Fe	7,013	33	39	23.35	30.21	+ .18	40.0	+ 2.4	61	23	52	10	11	27	32	28	16	46	0.23	0.6	2	5,050	ne.	26	se.	9	27	2	1	1.4	5.1
Flagstaff	6,907	12	25	23.45	30.15	+ .13	38.1	− 0.5	65	22	58	8	12	18	47	25	10	40	0.00	1.4	0	3,495	n.	25	e.	11	26	3	1	1.5	
Phoenix	1,108	50	56	28.86	30.02	+ .04	62.2	+ 3.7	85	23	80	35	13	45	44	45	27	29	0.00	0.5	0	2,555	e.	23	e.	11	25	4	1	1.1	
Yuma	141	16	46	29.84	29.99	+ .01	64.6	+ 2.3	87	2	80	40	13	49	39	49	34	36	T.	0.3	0	3,327	ne.	23	ne.	11	27	3	0	0.8	
Independence	3,910	51	58	26.10	30.11	+ .06	51.4	+ 3.6	74	10	64	30	24	38	34	38	23	34	0.00	0.2	0	4,005	nw.	30	n.	2	17	7	6	3.6	
Middle Plateau.							41.8	+ 2.3									51	0.03	0.8									3.2	
Carson City	4,720	82	92	25.37	30.14	+ .03	42.2	+ 0.8	65	21	58	17	19	26	42	35	27	58	T.	1.5	0	3,706	sw.	40	sw.	15	10	9	11	5.3	
Winnemucca	4,344	18	56	25.72	30.18	+ .04	41.6	+ 4.5	67	9	59	17	*	24	44	33	26	62	0.13	0.4	3	4,157	ne.	26	w.	15	12	12	6	4.2	
Modena	5,479	10	43	24.72	30.14	+ .06	41.4	+ 2.0	66	22	60	15	12	23	45	29	18	50	0.00	0.2	0	6,616	w.	36	w.	15	21	8	1	2.2	
Salt Lake City	4,366	105	110	25.76	30.18	+ .06	44.4	+ 4.6	66	1	56	26	24	33	30	35	24	45	0.00	1.4	0	3,406	nw.	22	ne.	10	25	3	2	1.9	
Grand Junction	4,608	43	51	25.55	30.21	+ .13	39.6	− 0.5	66	1	56	15	24	24	39	29	16	42	0.00	0.6	0	2,573	se.	19	n.	9	22	8	0	2.3	
Northern Plateau.							45.1	+ 6.5									62	0.27	1.2									5.7	
Baker City	3,471	53	59	26.53	30.16	.00	43.4	+ 6.6	69	6	53	24	19	34	33	36	27	56	0.17	0.8	5	5,060	se.	29	sw.	22	7	7	16	6.2	
Boise	2,739	61	68	27.29	30.18	+ .01	47.4	+ 8.9	67	1	58	29	14	36	34	38	29	53	0.18	1.1	4	2,625	se.	17	w.	27	8	11	11	5.7	
Lewiston	757	10	51	29.27	30.09	− .03	45.6	+ 3.1	63	2	55	27	19	36	30				0.16	1.7	6	2,972	e.	37	w.	4	9	6	15	5.9	
Pocatello	4,483	46	54	25.62	30.21	+ .07	42.1	+ 9.1	63	4	56	18	13	28	40	33	24	55	0.02	1.3	2	5,469	e.	30	sw.	28	16	13	1	3.1	
Spokane	1,929	101	110	28.03	30.11	+ .01	44.0	+ 6.2	64	4	52	24	12	36	29	40	35	75	0.87	0.8	11	4,793	ne.	36	sw.	20	2	10	18	7.6	
Walla Walla	1,000	71	79	29.00	30.08	− .05	48.0	+ 5.0	69	21	56	31	29	40	29	43	38	71	0.20	1.2	3	4,126	s.	34	s.	16	8	13	9	5.5	
N. Pac. Coast Reg.							50.3	+ 4.9									85	9.17	+ 2.3									3.4	
North Head	211	11	56	29.71	29.94	− .11	53.6	+ 5.4	71	9	58	41	18	49	16	51	49	86	9.30	+ 0.8	23	18,525	se.	89	se.	16	2	2	26	8.9	
Port Crescent	259	12	29	29.63	29.92	− .08	46.3	+ 4.0	59	10	52	31	18	41	22				9.70	+ 3.3	23	3,770	se.	31	s.	27	2	6	22	8.2	
Seattle	123	114	151	29.86	29.99	− .05	49.4	+ 4.1	62	7	54	38	20	45	19	47	45	87	8.81	+ 3.2	22	2,449	se.	33	sw.	27	1	4	25	8.8	
Tacoma	213	113	120	29.73	29.96	− .08	48.7	+ 4.5	62	7	54	35	12	43	25				11.88	+ 5.8	24	4,274	sw.	36	sw.	21	0	7	23	8.6	
Tatoosh Island	86	7	57	29.77	29.86	− .11	50.7	+ 4.3	65	12	55	40	18	47	16	49	47	88	14.53	+ 2.4	26	18,106	e.	80	s.	19	1	3	26	9.2	
Portland, Oreg.	154	68	96	29.84	30.00	− .10	51.4	+ 5.8	67	9	56	37	5	46	20	48	45	80	7.40	+ 1.6	21	4,656	se.	32	sw.	15	3	3	24	8.2	
Roseburg	518	56	60	29.47	30.04	− .08	51.6	+ 6.4	67	11	59	34	19	44	28	48	46	85	2.59	− 1.1	14	2,099	sw.	20	w.	27	7	8	15	6.6	
Mid. Pac. Coast Reg.							56.2	+ 2.7									79	2.33	− 0.9									5.6	
Eureka	62	62	80	30.01	30.07	− .04	56.0	+ 5.9	81	11	63	43	19	49	32	52	48	77	4.41	− 1.0	10	4,447	s.	36	se.	14	3	15	12	6.4	
Mount Tamalpais	2,375	11	18	27.62	30.11	+ .02	52.6		70	9	57	43	18	48	13	48	46	81	2.01		7	10,498	nw.	56	s.	1	14	9	7	4.4	
Red Bluff	332	50	56	29.75	30.11	.00	54.4	+ 0.5	78	9	64	38	20	45	29	49	45	77	2.31	− 0.8	6	2,615	se.	20	se.	15	12	12	6	4.5	
Sacramento	69	106	117	30.03	30.10	+ .01	54.6	+ 1.1	70	11	64	39	19	45	27	51	47	79	2.05	− 0.1	4	3,840	se.	22	se.	15	12	12	6	4.3	
San Francisco	155	161	167	29.96	30.13	+ .04	58.0	+ 1.7	74	9	63	49	19	53	20	54	51	80	1.07	− 1.6	5	3,851	w.	22	se.	14	18	10	2	3.7	
Point Reyes Light	490	7	50				58.2	+ 4.4	79	9	63	50	21	54	22				1.82	− 1.2	6	11,774	nw.	60	se.	14	9	11	10	5.4	
Southeast Farallon	30	9	17	30.07	30.10		58.7		74	9	59	53	29	51	14				1.58		6	9,168	nw.	43	s.	14	10	13	7	5.1	
S. Pac. Coast Reg.							61.4	+ 3.8									64	0.05	1.3									3.0	
Fresno	330	67	70	29.73	30.10	+ .04	55.6	+ 0.2	77	11	68	36	22	43	35	49	44	70	0.08	1.1	2	2,820	e.	20	nw.	27	14	10	6	4.1	
Los Angeles	338	116	123	29.67	30.04	+ .02	65.6	+ 6.4	91	8	78	45	13	53	32	53	42	54	0.00	1.4	0	3,572	w.	20	w.	23	21	8	1	2.3	
San Diego	87	94	102	29.91	30.00	− .02	64.2	+ 5.6	93	8	74	48	19	54	32	54	45	63	0.00	0.8	0	3,930	nw.	23	e.	11	24	3	3	1.8	
San Luis Obispo	201	47	54	29.85	30.07	+ .01	60.2	+ 3.2	90	10	73	34	22	47	42	52	46	67	0.13	1.9	3	3,486	n.	21	ne.	20	16	7	7	3.7	
West Indies.																														
Basseterre	29	41	54																											
Grand Turk	11	6	20	29.97	29.98	+ .03	77.8		89	11	82	66	23	74	15				5.82		13		e.	36	sw.	24	9	6	15	6.7	
Havana	57	87	105	29.95	30.01	+ .02	73.4	− 1.9	86	3	79	59	26	68	18				3.14	+ 0.1	8	7,397	e.	34	e.	19	6	15	9	6.0	
Kingston	286	41	55	29.61	29.90	+ .02	78.7		88	8	86	68	26	71	18				0.37		4		n.				9	17	4	4.6	
Roseau	25	36	45	29.90	29.93	+ .05	80.0		89	1	87	71	*	73					2.35		14		ne.								
San Juan	82	48	90	29.86	29.94	+ .04	78.7	+ 0.1	90	6	84	72	30	73	16	73	71	81	5.83	− 0.7	16	6,410	e.	30	e	20	6	17	7	5.5	

* More than one date.

TABLE II.—*Climatological record of voluntary and other cooperating observers, November, 1904.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Alaga				2.61	
Anniston	70	21	46.9	2.86	
Ashville	72	22	48.8	3.55	
Bermuda	76	27	54.5	1.61	
Boligee	78	25	52.8	3.46	
Bridgeport				3.82	
Burkeville				2.20	
Calera				3.07	
Camphill	79	29	54.7	1.26	
Cedar Bluff				3.81	
Citronelle	79	35	59.2	2.35	
Clanton	80	29	54.8	1.30	
Cordova	77	23	49.4	5.36	
Dadeville				2.49	
Daphne	77	35	59.2	2.87	
Decatur	74	28	50.2	1.92	
Delmar	77	32	54.6	2.10	T.
Demopolis				3.10	
Eufaula	72	30	53.4	2.81	
Evergreen	79	33	55.5	1.57	
Flomaton	83	32	57.4	2.18	
Florence *a*				3.52	
Florence *b*	74	24	49.8	3.52	
Fort Deposit	75	31	53.5	2.02	
Gadsden	75	25	50.0	2.43	
Goodwater	74	21	49.2	2.86	T.
Greensboro	74	30	53.6	3.03	
Greenville				2.70	
Hamilton	77	23	50.0	3.35	
Highland Home	75	34	56.6	2.81	
Letohatchie				2.08	
Livingston	75	26	49.4	2.76	
Lock No. 4	74	25	50.6	3.84	
Lucy	86	30	59.5	T.	
Madison Station	79	25	50.6	3.56	
Maplegrove	77	23	48.0	3.60	
Marion	75	30	53.0	2.62	
Milstead				2.58	
Newbern	79	27	54.3	2.09	
Notasulga				1.67	
Oneonto	73	22	47.8	4.05	
Opelika	72	38	55.2	2.60	
Ozark	76	34	53.5	2.23	
Prattville	76			2.72	
Pushmataha	75	26	53.0	3.29	
Riverton	78	22	48.6	2.66	
Scottsboro	83	22	47.7	5.74	
Selma	76	31	55.6	2.74	
Spring Hill	71	38	57.2	2.64	
Talladega	80	25	50.2	2.50	
Tallassee				2.37	
Thomasville	76	31	53.0	3.69	
Tuscaloosa	74	28	50.6	4.81	
Tuscumbia	72	26	49.2	4.07	
Tuskegee	78	31	56.2	2.20	
Union Springs	76	32	54.4	2.80	
Uniontown	76	24	53.1	2.18	
Valleyhead	72	23	48.7	2.89	
Wetumpka	80	27	54.3	1.91	
Alaska.					
Copper Center	34	−29	−3.4	0.36	4.2
Fort Liscum	45	6	25.9	2.20	9.5
Juneau	53	22	39.0	8.36	
Ketchemstock	34	−41	−3.6	0.03	0.5
Killisnoo	52	28	37.6	9.20	5.5
Loring	58	30	41.0	31.90	1.5
Orca	45	15	32.5	9.66	21.0
Petersburg	61	25	41.1	13.89	15.0
Sitka	59	30	40.2	8.78	1.0
Skagway	44	20	32.5	6.28	14.0
Sunrise	40	−11	18.3	2.37	17.3
Tanana		−37		0.10	1.0
Teikhill	40	−23	4.2	0.90	10.1
Arizona.					
Allaire Ranch				0.03	
Arizona Canal Co. Dam	89[f]	38[f]	65.0[f]	0.00	
Aztec	93	40	67.6	0.00	
Benson	82	22	54.2	0.09	
Bisbee	72	28	52.2	0.16	
Blue	68	14	45.6	0.12	
Bowie	80	20	50.4	0.40	
Buckeye	86	27	58.2	0.03	
Casagrande	90	24	57.2	0.00	
Champie Camp	89[e]	32[e]	61.3[e]	0.00	
Cochise *1	74	28	47.4	0.00	
Congress	79	43	63.8	0.00	
Douglas	89	17	52.0	0.00	
Dragoon *1	80	33	50.0	0.00	
Dudleyville	83	25	56.0	T.	
Duncan	77	17	48.2	0.10	
Fort Apache	76	11	44.1	0.00	
Fort Defiance	61	8	35.8	0.00	
Fort Grant	79			0.02	
Fort Huachuca	73	30	54.6	0.00	
Fort Mohave	86[f]	24[f]	59.6[f]	0.00	
Gilabend	89	38	64.6	0.00	
Grand Canyon	70	20	41.1	0.00	
Greaterville	75	30	53.6	0.12	
Arizona—Cont'd.	°	°	°	*Ins.*	*Ins.*
Greer				0.00	
Holbrook	70	14	41.4	0.00	
Jerome	72	30	55.4	0.00	
Kingman	75	29	55.2	0.00	
Maricopa	81	28	56.6	T.	
Mesa	91	30	61.4	0.00	
Mohawk Summit *1	86	53	69.8	0.00	
Natural Bridge				0.00	
Oracle	73	34	56.3	0.06	
Oro				0.00	
Parker	94	26	61.0	0.00	
Phoenix	87	29	59.2	0.00	
Prescott				0.00	
St. Johns	76	12	43.9	0.00	
San Carlos	80	21	52.8	0.00	
San Simon	77	22	51.4	0.05	
Sentinel *1	86[e]	45	60.1	0.00	
Signal				0.00	
Superstition				0.00	
Taylor	69	12	41.4	0.00	
Thatcher	78	23	53.2	0.00	
Tombstone	72	25	53.6	0.00	
Tuba	66	8	37.4	0.00	
Tucson	86	32	58.7	T.	
Upper San Pedro	78[e]	17[e]	50.6[e]	0.00	
Vail *5	85	49	67.0	0.00	
Wilcox	75	17	46.4	0.00	
Williams	72	15	44.2	0.00	
Yarnell				0.01	
Young	81	11	48.2	0.00	
Arkansas.					
Amity	89			1.16	
Arkadelphia	77	23	52.2	1.79	
Arkansas City				4.08	
Beebranch	79	19	51.4	0.50	
Black Rock				0.00	
Blanchard	79	23	52.2	3.95	
Brinkley	75	23	49.6	2.48	
Calico Rock				0.00	
Camden *a*				2.37	
Camden *b*	75	30	52.4	2.39	
Conway	79	21	52.6	1.05	
Corning	75	18	45.6	0.03	
Dallas	75	27	54.0	1.30	
Dardanelle				0.22	
Des Arc	88	23	51.8	1.65	T.
Dodd City	77	21	48.0	0.30	
Dutton	73	22	48.2	0.37	T.
Eldorado	80	27	52.8	2.41	
Elon				4.90	
Eureka Springs	77	23	50.0	T.	T.
Forrest City	76	26	51.0	2.43	
Fulton				2.20	
Hardy	79	23	51.4	0.04	
Heber	79	17	49.6	0.28	
Helena *a*				1.88	
Helena *b*	75	27	52.0	1.76	
Hope	80	26	55.0	2.04	
Howe	89	25	54.4	1.49	
Jonesboro	84	20	50.0	1.00	
Lacrosse	80	24	50.1	0.10	
Lake Village	78	24	52.3	3.80	
Lonoke	78	22	50.8	1.59	
Lutherville	77	21	51.2	0.19	
Luxora				0.35	
Malvern	79	23	50.4	1.95	
Mammoth Springs	73	18	45.7	T.	
Marked Tree				0.93	
Marvell	77	25	51.2	2.55	
Mossville	70	24	51.5	0.44	T.
Mount Nebo	72	32	53.8	0.63	T.
New Lewisville	79	24	54.6	2.27	
Newport *a*				0.60	
Newport *b*	80	22	49.6	0.62	
Oregon	78	18	49.0	0.46	T.
Osceola	77[d]	22[d]	49.4[d]	0.95	
Ozark	78	25	53.5	0.16	
Perry	79	24	51.9	0.55	
Pinebluff	74	24	49.8	2.69	
Pocahontas	74	20	48.9	0.00	
Pond	76	19	49.1	0.39	T.
Prescott	79	27	53.1	2.71	
Princeton	79	20	52.0	1.92	
Russellville	76	22	48.3	0.36	
Silversprings	77	21	49.8	0.09	T.
Spielerville	80	27	53.3	0.49	
Stuttgart	77	22	50.9	2.72	
Texarkana	80	28	56.2	2.50	
Warren	84	22	53.5	3.39	
White Cliffs				1.94	
Wiggs	78	20	50.5	1.28	
Winchester	79	23	51.5	3.65	
Witts Springs	83	23	48.8	0.25	T.
California.					
Alturas				0.55	T.
Angiola	89[j]	26[j]	54.8[j]	T.	
Azusa	95	41	64.6	0.00	
Bagdad	85	30	60.4	0.00	
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bakersfield	82	32	59.2	0.00	
Barstow	83	35	59.4	0.00	
Bear Valley				3.70	2.0
Berkeley	70	41	53.8	2.23	
Bishop	84	22	48.4	0.00	
Blue Canyon	72	28	47.0	2.81	
Boca *1	62	14	36.8	0.00	
Bodie	61	−1	31.0	T.	
Bowman				4.04	6.5
Branscomb	80	31	51.6	7.67	
Brush Creek	70	30	48.0	4.53	
Butte Valley				4.10	
Calexico				0.00	
Cambria				0.57	
Campbell	79	34	54.0	1.06	
Campo				0.00	
Cedarville	65	20	42.8	0.09	1.0
Chico	68	34	51.7	2.29	
Chino *5	82	35	50.1	0.00	
Cisco *1	65	26	40.8	0.95	6.0
Claremont	94	41	66.6	0.00	
Cloverdale	82	39	55.8	3.48	
Colusa	70	34	52.8	1.43	
Corning *1	76	38	55.0	2.60	
Coronado				0.00	
Craftonville				0.00	
Crescent City	77	38	54.2	8.46	
Crockers				1.09	
Cuyamaca	65	14	43.8	0.00	
Delano *1	78	38	56.0	0.09	
Delta	82	36	56.6	5.65	
Dobbins	80	39	58.0	4.13	
Drytown	72	35	52.4	2.05	
Dunnigan *1	68	38	53.7	1.47	
Durham				2.21	
Elcajon	94			0.00	
Electra				1.99	
Elmwood	83	30	54.5	0.13	
Elsinore	88	30	59.5	0.00	
Escondido	87	21	55.0	0.00	
Folsom				3.00	
Fordyce				3.20	16.0
Fort Bragg				3.96	
Fort Ross	69	43	55.6	5.98	
Foster				0.00	
Georgetown	74	36	53.7	2.05	
Gilroy (near)	85	31	55.3	0.76	
Glendora				0.00	
Greenville	67	20	43.0	2.58	
Hanford	83	30	54.4	0.31	
Healdsburg	85	35	55.2	3.37	
Hollister	85	34	55.2	0.55	
Idylwild	81	29	57.6	0.00	
Iowa Hill *1	72	38	53.4	3.00	
Irvine				0.00	
Isabella	82	23	52.1	0.00	
Jamestown	74	52	52.2	0.58	
Jolon				0.39	
Kennedy Gold Mine				1.79	
Kentfield				3.88	
Kernville				0.00	
King City	90	32	57.1	0.30	
Laguna Valley				0.00	
Lamesa				0.00	
Laporte	73	27	44.6	4.60	4.5
Legrande	79	25	56.3	0.15	
Lemoncove	87	36	59.4	0.22	
Lick Observatory	73	35	51.0	2.05	
Livermore	83[d]	31[d]	54.5[d]	0.78	
Lodi	67	34	52.2	1.50	
Los Gatos	74	38	54.4	1.15	
Lowe Observatory				0.00	
Magalia	79	33	53.1	4.08	
Mammoth *1	85	37	62.8	0.00	
Marysville	76	34	53.8	3.08	
Merced	79	32	54.8	0.29	
Mercury				4.13	
Mills College				1.71	
Milo				0.27	
Milton (near)	73	39	5.52	1.72	
Modesto *1	89	44	58.9	0.50	
Mohave	77	37	57.2	0.00	
Mokelumne Hill				1.72	
Montague	72	19	46.4	1.24	
Monterio	78	33	56.8	0.25	
Monterey *1	77	40	55.2	0.44	
Mount St. Helena				4.44	
Napa	79	38	55.2	2.01	
Needles	86	37	63.9	0.00	
Nellie				0.00	
Nevada City	79	28	50.7	4.03	
Newcastle	83	34	59.0	2.89	
Newman	75	33	54.6	0.67	
Niles	78	38	55.4	1.45	
Nordhoff				T.	
North Bloomfield	85	31	50.6	3.72	
Oakland	72	44	56.0	1.86	
Ontario (near)	89	36	60.0	0.00	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Orland	75	36	54.2	1.96	
Orleans	75	43	56.2	5.53	
Oroville (near)	72	36	53.8	4.09	
Palermo	73	33	52.6	3.85	
Peachland	76	35	53.3	3.35	
Pilot Creek				2.89	
Pine Crest	90	50	65.8	T.	
Placerville	70	28	47.9	1.95	
Point Lobos	74	53	62.6	1.09	
Porterville	82	34	56.6	0.05	
Poway				0.00	
Quincy	57	24	42.0	4.14	
Redding	79	37	53.5	2.69	
Reedley	81	33	54.6	0.30	
Represa	68	40	53.2	2.94	
Riovista	69	36	53.2	1.38	
Riverside	90	28	59.2	0.00	
Rohnerville				4.01	
Sacramento	66	37	52.7	2.30	
Salinas	85	33	57.0	0.53	
Salton	93	33	64.4	0.00	
San Bernardino	92	28	60.4	0.00	
San Jacinto	76	31	53.0	0.00	
San Jose	82	37	56.2	1.20	
San Leandro	74	39	53.9	1.95	
San Mateo[*1]	75	43	58.7	1.03	
San Miguel[*1]	79	29	53.9	0.40	
San Rafael	75	40	55.8	2.45	
Santa Barbara	91	44	63.1	T.	
Santa Clara College	84	34	55.2	1.04	
Santa Cruz	88	36	55.9	2.37	
Santa Maria	87	38	60.1	0.03	
Santa Rosa	78	33	53.2	2.74	
Sausalito				1.52	
Shasta	83	36	55.7	4.51	
Sierra Madre	85	47	64.3	0.00	
Sisson	65	27	44.4	2.74	
Snedden				0.00	
Sonoma				1.91	
Sonora	61	39	51.2	0.32	
Stockton	68	35	50.8	1.28	
Storey	81	31	52.4		
Summerdale	72	29	50.4	0.63	
Summit	60	26	41.6	1.33	12.0
Susanville	58	24	40.4	0.70	
Tehama[*1]	72	40	57.2	2.80	
Tejon Ranch	77	40	57.4	0.16	
Truckee	64	29	42.4	T.	
Tulare	86	30	56.0	T.	
Tustin				0.00	
Ukiah	74	34	52.1	2.94	
Upland	84	40	59.9	0.00	
Upperlake	78	29	50.6	2.32	
Upper Mattole				9.30	
Vacaville[*1]	73	36	53.8	1.66	
Ventura	97	46	65.2	0.00	
Visalia	79[4]	30	54.2	0.00	
Volcano	91	43	65.5	0.00	
Wasco	83	29	54.8	0.00	
Weldon				0.00	
Westpoint				2.02	
Wheatland	68	34	51.8	2.92	
Willow	75	40	55.8	1.78	
Yosemite				0.69	
Yreka				1.98	
Zenia	78	32	50.2	8.34	
Colorado.					
Akron				0.00	
Alford	68	1	39.7	T.	T.
Antelope Springs	55	−4	27.2	T.	T.
Ashcroft	55	−6	30.6	0.14	2.0
Blaine	76	11	43.7	0.12	0.2
Boulder	71	16	48.4	0.08	1.0
Boxelder				T.	0.2
Breckenridge	57	−9	30.0	0.10	2.0
Burlington	75	10	42.7	T.	T.
Canyon	75	10	45.2	T.	T.
Cheesman	69	2	40.9	T.	T.
Cheyenne Wells	72	12	43.6	0.00	
Clearview	60	−7	32.5	0.20	2.5
Collbran	62	5	36.0	0.00	
Colorado Springs	67	4	41.6	T.	T.
Conejos	61	1	36.2	0.00	
Cripplecreek				T.	T.
Delta	65	4	34.9	0.00	
Durango	64	11	38.8	0.00	
Eagle	70	0	33.1	T.	T.
Fort Collins	75	0	39.7	0.00	
Fort Morgan	66	7	38.4	T.	0.5
Fowler				T.	T.
Fox	74	5	41.6	T.	T.
Fruita	65	8	35.8	T.	T.
Garnett	59	−6	30.4	0.00	
Gilman				0.00	
Gleneyre	72	1	39.1	0.04	0.2
Glenwood	64	2	35.7	0.00	
Grand Valley	68	7	37.3	0.04	
Greeley	70	5	40.5	T.	T.
Colorado—Cont'd.					
Grover				T.	T.
Gunnison	58	−4	26.9	0.00	
Halls Gulch	45	−3	26.9	0.09	0.7
Hamps	72	−1	40.2	T.	T.
Hoehne	75	1	40.6	T.	
Holly	76	9	44.0	0.00	
Husted	66	−7	35.2	0.05	1.5
Lake Moraine	56	4	32.0	0.30	6.0
Lamar	75	10	43.8	0.05	0.5
Laporte				0.00	
Las Animas	76	3	40.6	0.00	
Lay	61	−10	30.2	0.00	
Leadville	56	1	33.2	T.	T.
Leroy	72	13	43.0	0.04	0.6
Longs Peak	56	−2	34.5	T.	T.
Mancos	64	9	38.9	0.00	
Marshall Pass				0.02	1.0
Meeker	69	−2	33.6	T.	T.
Montrose	68	8	37.2	0.00	
Pagoda	75	1	39.2	0.00	
Platte Canyon				0.35	4.5
Rockyford	75	5	40.2	0.00	
Saguache	69	−2	34.9	0.00	
Salida	68	0	37.9	0.02	0.5
San Luis	64	−1	34.6	0.00	
Santa Clara	67	−2	38.6	0.63	10.0
Sapinero	54	0	31.5	T.	T.
Sheridan Lake	74	7	42.3	0.00	
Silt	60	10	40.9	0.00	
Silverton	62	1	31.4	0.00	
Sugar City				0.00	
Sugar Loaf	62	5	39.8	0.22	0.4
Trinidad	70	5	43.4	T.	0.5
Victor	55	−4	34.4	T.	T.
Vilas				0.25	
Wagon Wheel	60	−4	29.5	0.00	
Walden	56	−7	30.7	T.	T.
Waterdale	65	4	34.0	0.00	
Westcliffe	65	−11	34.0	0.05	2.0
Whitepine	56	−2	29.6	0.03	0.5
Wray	77	9	43.1	0.05	0.5
Yuma				T.	T.
Connecticut.					
Bridgeport	62	13	38.4	2.26	0.8
Canton	59	7	34.2	1.30	1.0
Colchester	62	10	36.3	2.74	1.0
Falls Village				1.49	4.2
Hartford[b]	58	14	35.6	1.66	
Hawleyville	59	10	36.4	1.56	3.6
Lake Konomoc				2.09	
New London	60	16	39.2	2.63	0.8
North Grosvenor Dale	57	2	33.1	1.67	
Norwalk	60	9	36.2	2.14	1.5
Southington	60	8	36.0	1.35	2.5
South Manchester				1.65	2.0
Storrs	56	9	35.6	1.47	T.
Voluntown	65	0	36.7	2.03	2.3
Wallingford				2.28	0.2
Waterbury	61	9	36.4	1.59	1.0
West Cornwall	57	8	32.5	1.24	11.5
West Simsbury				1.22	3.0
Delaware.					
Delaware City				2.52	T.
Milford	62	21	43.2	2.49	
Millsboro	67	19	42.3	1.82	
Newark	62	18	40.7	2.03	
Seaford	66	21	42.4	2.01	0.5
District of Columbia.					
Distributing Reservoir[*5]	65	26	44.8	1.50	
Receiving Reservoir[*5]	64	25	44.0	1.50	
West Washington	70	23	42.6	2.30	1.5
Florida.					
Apalachicola	78	42	61.4	3.06	
Archer	83	32	59.8	2.45	
Avon Park	83	40	64.8	2.90	
Bartow	82	38	62.6	3.06	
Bonifay	77	30	57.4	3.26	
Brooksville	83	38	62.7	2.04	
Carrabelle	84			2.80	
Clermont	85	48	65.0	2.27	
De Funiak Springs	76	31	56.8	3.54	
Deland	85	31	60.3		
Eustis	84	37	63.0	2.02	
Federal Point	82	37	61.9	2.38	
Fernandina	76	40	61.2	4.51	
Flamingo	83	53	71.0	5.66	
Fort Meade	83	36	63.6	3.22	
Fort Pierce	83	46	64.4	5.40	
Gainesville	84	35	59.8	2.63	
Grasmere	82	40	61.4		
Huntington	80	32	59.9	2.63	
Hypoluxo	81	52	69.0	5.72	
Inverness	80	36	61.0	2.21	
Jasper	81	30	57.4	1.77	
Kissimmee	82	41	63.2	3.15	
Lake City	84	34	59.8	2.05	
Macclenny	84			3.00	
Madison	81	35	59.6	1.81	
Florida—Cont'd.					
Malabar	86	43	66.5	2.54	
Manatee	82	40	64.9	3.19	
Marco	82	54	70.0	2.51	
Marianna	80	27	57.8	3.31	
Merritt Island	81	49	66.2	3.73	
Miami	85	49	70.4	5.21	
Middleburg	83	28	58.0	2.64	
Molino	80	27	56.0	2.64	
Monticello	83	30	60.0	2.20	
Myers				1.93	
New Smyrna	82	37	63.0	2.44	
Nocatee	81	44	65.5	2.95	
Ocala	82	35	62.0	2.45	
Orange City		33		2.32	
Orange Home	84	35	62.2	1.98	
Orlando	85[e]	39[e]	64.3[e]	1.80	
Pinemount	83			1.88	
Plant City	83	38	62.5	3.39	
Rockwell		34[d]		1.96	
St. Andrews	78	30	57.1	3.89	
St. Augustine	85	38	62.4	3.53	
St. Leo	83	38	62.8	2.30	
Stephensville	83	30	59.6	1.50	
Sumner	82	29	59.6	2.59	
Switzerland	81[d]	36[d]	60.6[d]	2.67	
Tallahassee	78	38	59.9	3.10	
Tarpon Springs	83	37	62.8	2.66	
Titusville	85	40	63.9	3.19	
Wausau		29		2.51	
Wewahitchka	79	31	58.0	4.13	
Georgia.					
Abbeville				4.54	
Adairsville	68	27	50.0	3.28	
Albany	80	30	56.8	1.77	
Allapaha	76	29	53.0	3.59	
Americus	73	33	53.4	3.53	
Athens	71	29	50.0	2.58	T.
Bowersville	70	27	50.2	2.79	
Butler				3.18	
Camak	78	31	55.2	2.55	
Carrollton	73	27	49.6	2.85	T.
Canton				2.35	T.
Carlton				2.56	
Clayton	70	21	46.8	2.61	
Columbus	76[e]	30[e]	55.0[e]	1.92	
Covington	75	27	53.0	3.37	
Cordele	76	27	52.6	3.66	
Cuthbert	74	32	53.5	2.06	
Dahlonega	70	25	48.6	2.71	
Dawson	77[e]	26[e]	55.7[e]	3.52	
Diamond	69	22	46.8	2.77	
Dublin				3.25	
Dudley	81	28	55.5	4.15	
Eatonton	71	30	52.4	2.62	
Elberton	69	29	51.0	2.78	
Experiment	72	30	53.4	2.65	
Fitzgerald	79	28	55.2	3.95	
Fleming	76	28	55.2	4.66	
Forsyth	76	31	54.1	3.59	
Fort Gaines	73	31	54.1	2.92	
Gainesville	67	30	49.7	2.22	
Gillsville	73	30	52.5	3.12	
Glenville	75	32	54.6	3.78	
Greenbush	69	24	48.4	4.61	
Greensboro	75	25	50.4	2.60	
Griffin	72	31	52.2	2.87	
Harrison	76	26	52.8	3.56	
Hawkinsville	81	25	53.2	3.27	
Lost Mountain	72	25	49.7	3.03	
Louisville	72	30	52.2	3.16	
Lumpkin	79	30	56.6	3.10	
Marshallville	72	30	54.0	3.60	
Mauzy	79	29	57.4	3.22	
Milledgeville	72	28	51.4	2.70	
Millen	78	27	53.8	3.27	
Montezuma				2.11	
Monticello	74	28	53.3	3.35	
Morgan	75	30	54.4	3.80	
Newnan	74	29	51.8	2.28	
Point Peter	71	25	50.1	2.96	
Poulan	79	27	54.6	2.94	
Putnam	75	28	54.2	3.07	
Quitman	80	29	56.6	2.55	
Ramsey	71	23	50.2	3.76	T.
Resaca				4.16	
Rome	71	25	48.7	4.50	
St. Marys	76	31	58.6	2.23	
Statesboro	77	30	55.9	4.31	
Talbotton	75	27	53.4	3.13	
Tallapoosa	75	22	48.9	0.68	
Thomasville	81	31	58.0	3.00	
Toccoa	71	26	49.1	3.54	
Vidalia	77	30	56.5	4.53	
Valona	76	32	56.6	4.40	
Washington	72	30	51.0	2.42	
Waverly	81	28	57.2	3.89	
Waycross	78	31	56.4	3.34	
Waynesboro	73	30	53.0	3.04	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Georgia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Westpoint	76	26	51.5	2.59	
Woodbury	72	23	50.0	2.56	
Idaho.					
Albion	64	14	39.8	0.14	
American Falls	63	11	38.6	0.03	
Blue Lakes	75	20	47.5	T.	
Caldwell	63	23	43.1	0.20	
Cambridge	68	19	41.2	0.66	
Chesterfield	63	1	34.2	T.	
Dewey	64	12	41.4	0.27	1.8
Ditto Creek	67	26	47.6	0.28	
Forney	59	6	35.2	0.77	4.0
Garnet	72	26	47.6	0.00	
Grangeville	63	22	44.4	1.26	1.0
Idaho City	70	18	42.3	0.72	
Lake	62	10	36.6	T.	T.
Lakeview	56	29	43.3	3.20	
Lost River	62	11	35.9	T.	T.
Lovell	73[e]	20[e]	46.4[e]	0.90	
Malad City[d]	65	15	39.4	.....	
Meadows	62	18	37.0	1.73	
Milner	73	15	42.6	T.	
Moscow	60	26	44.4	0.75	
Murray	59	17	38.0	3.11	
Oakley	65	20	43.8	0.00	
Ola	66	21	41.6	0.50	
Paris	62	11	35.4	T.	T.
Payette	71	20	42.2	0.28	
Pollock	69	28	47.6	0.66	
Poplar	.....	.....	.....	0.25	
Porthill	55	25	39.6	2.90	
Roosevelt	55	11	35.7	1.01	16.5
St. Maries	68	24	44.1	2.29	
Soldier	69	9	36.0	0.26	
Vernon	74	12	38.6	0.11	
Victor	66	12	39.3	0.30	3.0
Weston	68	11	38.4	0.08	
Illinois.					
Albion	69	22	43.1	0.60	
Aledo	70	12	41.9	0.15	
Alexander	73	13	42.6	0.05	
Antioch	69	15	39.9	0.75	
Ashton	68	12	39.8	0.02	T.
Astoria	70	15	41.4	0.14	
Aurora	68	16	40.3	0.06	
Benton	73	23	46.6	0.52	
Bloomington	76	15	44.5	0.19	
Bushnell	73	14	43.8	0.00	
Cambridge	71	15	43.6	0.21	
Carlinville	75	16	44.2	0.08	T.
Carrollton	75[f]	16[f]	43.0[f]	0.10	
Charleston	69	19	43.2	0.18	
Cisne	75	21	45.7	0.70	
Coatsburg	71	15	42.9	0.36	
Cobden	72	24	47.6	0.32	
Colchester	78	14	43.8	0.26	
Danville	73	12	41.6[e]	0.07	T.
Decatur	73	17	43.2	0.07	
Dixon	68	13	38.6	0.03	
Effingham	70	20	43.2	0.26	
Equality	74	24	46.6	0.39	
Flora	69	20	42.0	0.86	
Friendgrove	78	20	43.4	0.73	T.
Galva	72	12	41.0	0.23	
Greenville	76	19	45.7	0.20	
Griggsville	73	16	45.9	0.15	
Halfway	68	25	47.0	0.53	
Havana	72	15	43.8	0.17	
Henry	73	13	41.8	T.	
Hillsboro	74	19	45.0	0.09	
Hoopeston	68	13	40.2	0.08	
Joliet	67	17	41.3	0.10	T.
Kishwaukee	71	11	40.2	0.02	
Knoxville	71	12	40.6	0.20	
Lagrange	70	16	41.3	T.	T.
Laharpe	74	14	41.5	0.50	
Lanark	73	11	39.3	0.17	T.
Loami	.....	.....	.....	T.	
McLeansboro	70	22	44.5	0.94	T.
Martinsville	.....	.....	.....	0.25	
Martinton	74	15	42.4	0.09	T.
Mascoutah	70	23	43.2	0.70	
Mattoon	76	20	47.2	0.08	
Minonk	73	13	42.0	T.	
Monmouth	69	13	40.6	0.22	
Morrison	74	11	40.4	0.02	T.
Morrisonville	72	14	43.4	0.07	
Mount Pulaski	73	15	43.7	0.02	
Mount Vernon	75	22	47.2	0.81	
New Burnside	73	22	47.6	0.51	
Olney	68	22	43.6	0.94	
Ottawa	71	16	42.4	0.08	
Palestine	71	21	44.1	1.10	
Pana	70	15	44.0	0.10	
Paris	71	18	44.5	0.30	
Peoria	71	17	44.3	0.12	
Philo	70	11	40.2	0.35	
Plumhill	73	21	44.9	0.94	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Illinois—Cont'd.	°	°	°	*Ins.*	*Ins.*
Pontiac	70	15	43.0	0.06	
Rantoul	72	13	42.3	0.10	T.
Raum	75	23	47.2	0.32	
Riley	69	14	40.4	0.15	T.
Robinson	71	20	43.8	0.92	
Rushville	73	16	44.3	0.03	
St. Charles	71	12	40.0	0.01	
St. John	74	21	45.4	0.65	
Shobonier	73	19	44.4	0.50	
Streator	72	14	41.9	T.	
Sullivan	73	16	43.1	0.06	
Sycamore	70	14	39.5	0.03	
Tilden	73	22	45.2	0.86	
Tiskilwa	68	12	41.8	0.10	
Tuscola	70	15	41.2	0.08	T.
Urbana	69	14	42.2	T.	
Walnut	71	14	42.4	0.06	
Warsaw	.....	.....	.....	T.	
Winchester	72	16	43.2	0.05	
Windsor	71	16	41.8	0.09	
Winnebago	69	11	40.3	0.13	
Yorkville	67	15	39.8	0.00	
Zion	69	11	39.4	T.	T.
Indiana.					
Anderson	68	18	41.9	0.11	
Angola	65	20	40.2	0.14	0.8
Auburn	67	18	38.2	0.13	
Bloomington	67	20	41.0	1.00	
Butlerville	70	17	43.0	0.78	T.
Cambridge City	66	17	38.2	0.32	T.
Columbus	71	16	42.2	0.67	
Connersville	70	17	41.6	0.53	
Crawfordsville	67	17	41.2	0.10	
Delphi	72	15	40.3	0.12	T.
Farmersburg	73	17	42.1	0.59	
Farmland	66	18	41.2	0.28	T.
Fort Wayne	69	19	40.5	0.19	T.
Franklin	70	19	42.3	0.49	T.
Greencastle	66	16	42.4	0.15	T.
Greenfield	70	16	42.1	0.26	T.
Greensburg	70	15	42.8	0.60	T.
Hammond	69	18	41.8	0.20	T.
Hector	68	15	40.3	T.	
Holland	76	19	45.4	0.30	
Huntington	69	17	40.2	0.24	T.
Jeffersonville	68	24	44.4	0.24	T.
Kokomo	70	14	41.4	0.11	
Lafayette	70	16	40.8	0.06	
Laporte	.....	21	.....	0.83	0.1
Logansport	68	18	39.6	0.10	T.
Madison *a*	70	17	44.5	0.50	T.
Madison *b*	.....	.....	.....	0.50	
Marengo	70	17	42.1	0.40	
Marion	71	17	40.9	0.35	T.
Markle	71	15	41.0	0.20	T.
Mauzy	70[f]	14[f]	40.8[f]	0.50	T.
Moores Hill	67	18	43.2	0.58	T.
Mount Vernon	71	22	42.8	0.60	
Northfield	66	13	39.0	0.08	T.
Paoli	72	16	44.2	0.42	
Princeton	74	21	44.4	0.50	
Rensselaer	67	16	40.4	0.29	T.
Richmond	68	16	39.8	0.33	T.
Rochester	70	17	40.6	0.48	T.
Rockville	69	10	41.8	0.27	
Salem	74	16	43.4	0.43	T.
Scottsburg	68	22	43.6	0.81	
Seymour	82	18	45.8	0.45	
South Bend	70	20	40.0	0.37	0.5
Syracuse	72	15	39.8	0.11	0.5
Terre Haute	68	21	44.5	0.29	
Topeka	66	20	40.4	T.	T.
Valparaiso	69	17	42.3	0.53	
Vevay	70	22	43.2	0.35	T.
Vincennes	75	22	44.0	0.71	
Washington	68[c]	21[b]	42.6[e]	0.55	
Winamac	72	11	42.8	T.	
Worthington	81	17	44.5	0.80	T.
Indian Territory.					
Ardmore	85	21	54.2	T.	
Calvin	.....	.....	.....	0.28	
Chickasha	82	16	53.6	T.	T.
Durant	80	22	53.7	0.50	
Fairland	78[g]	18[f]	52.2[g]	T.	
Fort Gibson	.....	.....	.....	0.14	
Goodwater	81	20	51.2	0.80	
Healdton	80	14	52.6	0.25	T.
Holdenville	81	23	55.6	0.25	
Marlow	81	14	53.6	T.	T.
Muskogee	79	22	52.2	0.37	
Okmulgee	80	20	50.5	0.47	1.5
Pauls Valley	90	12	51.7	T.	T.
Ravia	89	23	53.7	0.00	
Roff	84	21	55.4	T.	
Tulsa	.....	.....	.....	0.23	T.
Vinita	79	18	48.7	0.30	
Wagoner	82	18	50.4	0.80	
Webbers Falls	79	20	49.6	0.68	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa.	°	°	°	*Ins.*	*Ins.*
Afton	68	13	42.8	T.	
Albia	72	10	43.6	0.08	
Algona	68	7	38.5	0.32	1.0
Allerton	75	11	43.4	0.06	T.
Alta	70	8	40.0	0.31	1.5
Amana	71	10	40.2	0.19	
Ames	73	11	41.3	0.02	
Atlantic	72	9	40.4	0.08	0.8
Audubon	70	8	39.6	0.17	1.3
Baxter	72	9	40.7	0.08	
Bedford	74	10	41.8	0.08	T.
Belleplaine	70	6	39.3	0.20	
Bonaparte	74	12	42.4	0.50	
Britt	68	4	37.8	0.26	1.3
Buckingham	.....	.....	.....	0.18	T.
Burlington	74	13	43.8	0.13	
Carroll	74	6	41.6	0.18	1.0
Cedar Rapids	72	12	39.6	0.09	
Chariton	74	9	43.1	T.	
Clarinda	77	12	42.2	0.09	T.
Clearlake	65	9	38.4	0.25	T.
Clinton	69	11	38.9	0.10	
College Springs	70	14	44.0	0.10	
Columbus Junction	79	12	42.4	0.16	
Corydon	76	9	44.3	0.05	
Cumberland	.....	.....	.....	T.	
Decorah	68	10	38.8	0.35	
Delaware	67	7	38.2	0.09	
Denison	71	9	40.8	0.15	1.0
Desoto	77	10	43.8	0.10	
Dows	69	8	38.8	0.05	0.5
Elkader	75	9	38.7	0.14	T.
Estherville	72	9	39.2	0.14	1.5
Florence	.....	.....	.....	0.19	T.
Forest City	71	8	38.4	0.22	T.
Fort Dodge	71	10	40.6	0.20	0.5
Fort Madison	.....	.....	.....	0.43	
Galva	68[a]	7[b]	36.7[e]	0.09	0.5
Gilman	.....	.....	.....	0.25	T.
Glenwood	71	20	45.0	0.50	
Grand Meadow	66	8	39.4	0.18	T.
Greene	70	9	39.6	0.33	
Grinnell	68	11	41.4	0.12	T.
Grinnell (near)	74	11	42.0	0.10	
Grundy Center	72	6	40.7	0.23	
Guthrie Center	71	10	41.9	0.13	0.8
Hampton	74	9	41.4	0.40	0.2
Hanlontown	72	5	38.5	0.13	
Harlan	68	8	39.4	0.17	1.0
Hopeville	73	11	43.3	0.02	
Humboldt	72	10	40.0	0.20	
Ida Grove	67	8	38.3	.....	
Independence	70	8	39.0	0.05	
Indianola	72	11	43.1	0.03	T.
Inwood	65	9	38.4	T.	T.
Iowa City	73	10	39.4	0.25	
Iowa Falls	68	7	37.8	0.23	T.
Keosauqua	73	12	39.8	0.14	
Lacona	.....	.....	.....	0.03	
Larrabee	69	8	38.8	0.29	2.9
Leclaire	.....	.....	.....	0.31	
Lemars	68	9	38.6	0.05	T.
Leon	68	14	43.5	0.09	T.
Little Sioux	73	10	42.2	0.20	1.5
Logan	68	12	40.5	0.20	2.0
Maple Valley	.....	.....	.....	0.10	
Maquoketa	73	10	37.4	0.22	
Marshalltown	75	10	39.6	0.17	T.
Mason City	67	10	39.8	0.20	
Massena	70	10	41.2	0.06	
Mountayr	76	13	45.4	0.41	T.
Mount Pleasant	72	11	41.8	0.22	T.
Mount Vernon	73	8	40.7	0.13	
Muscatine	.....	.....	.....	0.20	
New Hampton	67	7	39.0	0.10	
Newton	68	10	41.1	0.08	
Northwood	67	9	38.6	0.25	
Odebolt	70	9	40.2	0.24	1.8
Ogden	70	9	40.8	0.02	0.2
Olin	70	10	39.6	0.01	T.
Onawa	72	12	42.2	0.30	2.5
Osage	66	9	38.4	0.17	T.
Osceola	.....	.....	.....	0.06	
Oskaloosa	73	11	42.0	0.03	
Pacific Junction	69	12	40.6	0.18	1.8
Perry	70	10	41.2	T.	T.
Plover	68	8	38.6	0.20	1.0
Pocahontas	70	9	40.2	0.11	1.0
Redoak	64	19	42.2	0.07	T.
Ridgeway	75	7	41.7	0.29	0.1
Rock Rapids	70	9	41.4	T.	T.
Rockwell City	68	9	41.0	0.00	
Ruthven	80	8	40.6	0.05	0.5
Sac City	70	10	41.4	0.24	2.0
St. Charles	79	12	45.8	0.09	
Sheldon	74	6	40.2	0.16	0.2
Sibley	70	6	38.0	0.05	0.5
Sigourney	70	10	41.4	T.	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Sioux Center	67	9	39.4	0.10	1.0
Stockport	75	14	42.7	0.15	T.
Storm Lake	69	10	40.0	0.03	0.3
Stuart	67	13	43.2	0.10	T.
Thurman	69	10	40.9	0.18	1.8
Tipton	70	12	41.8	0.12	
Toledo	72	9	40.6	0.15	
Vinton	72	8	41.2	0.10	
Wapello	70[e]	15[e]	43.6[e]	0.12	
Washington	73[f]	12[g]	40.2[g]	0.23	
Washta				0.10	1.0
Waterloo	75	10	40.6	0.21	T.
Waukee	80	10	45.2	0.10	
Waverly	70	10	39.5	0.21	T.
Westbend	68	7	38.8	0.08	0.3
Whitten	68	9	39.5	T.	T.
Wilton Junction	70	10	40.2	0.35	
Winterset	79	9	43.8	0.30	
Woodburn				0.12	T.
Zearing	71	7	41.5	0.16	T.
Kansas.					
Achilles	76	7	42.2	0.07	0.1
Alton	77	14	44.4	0.40	4.0
Atchison	70	18	45.1	0.32	T
Baker	74	17	44.4	0.60	T.
Burlington	77	16	47.0	0.30	T.
Chapman	80	18	45.5	0.07	T.
Clay Center	76	17	43.7	0.25	T.
Coffeyville	84	20	54.6	0.10	T.
Colby	78	7	43.3	T.	T.
Columbus	75	20	48.2	0.15	T.
Cunningham	80	12	48.2	0.02	0.2
Dresden	73	13	45.6	0.10	T.
Eldorado	75	13	47.4	0.11	T.
Ellinwood	74	15	46.0	0.12	1.0
Ellsworth	83	16	47.0	0.24	2.4
Emporia	75	19	46.8	0.15	T.
Englewood	78	14	47.0	T.	T.
Enterprise	76	17	43.6	0.23	T.
Eureka				0.05	
Fall River	76	10	45.2	0.06	
Farnsworth	78	12	45.4	0.02	T.
Forsha	78	12	47.8	T.	T.
Fort Leavenworth	73	22	48.2	0.21	
Fort Scott	78	19	48.5	0.12	
Frankfort	75	15	44.2	0.20	0.5
Fredonia				0.20	0.5
Garden City	80	8	46.2	0.09	0.5
Gove[e1]	79	11	44.6	0.00	
Grenola	76	11	47.8	T.	T.
Harrison	72	13	43.0	0.10	1.0
Holton		17		T.	T.
Horton	74	18	46.0	0.40	T.
Hoxie	73	9	43.5	T.	T.
Hugoton	74	14	44.4	T.	T.
Hutchinson	77	11	46.2	0.14	1.2
Independence	76	13	49.2	0.16	0.2
Jetmore				0.02	0.2
La Crosse	77[e]	12[e]	44.4[e]	0.10	1.0
Larned	76	11	44.8	0.20	2.0
Lebanon	71	14	42.0	0.10	1.0
Lebo	75	16	46.3	0.20	T.
Macksville	74	12	45.0	0.05	T.
McPherson	74	16	46.4	0.24	T.
Manhattan *b*	78	19	46.0	0.35	T.
Manhattan *c*	76	18	45.3	0.30	T.
Marion	70[e]	16[e]	45.4[e]	T.	T.
Medicine Lodge	80	10	48.6	0.04	0.4
Moran	78	17	48.8	0.34	T.
Mounthope	72	20	49.0	0.03	T.
Ness City	75	14	46.6	0.12	1.2
Newton	74	12	47.4	T.	T.
Norton	75	0	42.9	0.35	1.5
Norwich	74	12	49.2	0.10	1.0
Oberlin				0.20	
Osage City	76[e]	15[e]	46.8[e]	0.28	
Osborne				0.26	2.0
Oswego	78	17	48.6	0.18	
Ottawa	76	14	45.8	0.26	T.
Pleasanton	76	19	47.9	0.31	
Pratt	77	14	47.6	T.	T.
Republic	75	16	42.9	0.10	T.
Rome	79	12	49.2	0.15	1.0
Russell	76	12	46.0	0.07	0.5
Salina	73	16	45.0	0.16	1.0
Sedan	76	18	47.8	0.12	T.
Toronto	82	10	45.8	0.25	
Ulysses	72[e]	13[e]	44.0[e]	0.25	0.5
Valley Falls	80	16	46.1	0.16	T.
Wakeeney (near)	75	15	46.7	0.04	0.4
Wallace	76	8	41.6	T.	
Walnut	78	18	49.2	0.17	T.
Wamego[e1]	74	14	44.0	0.28	1.3
Winfield	75	14	47.6	0.09	T.
Yates Center	82[e]	12[e]	47.6[e]	0.35	
Kentucky.					
Alpha	72	23	46.3	3.10	T.
Anchorage	72	14	43.2	2.40	T.
Kentucky—Cont'd.					
Bardstown	75	20	45.9	0.89	
Beattyville	74	17	42.0	0.70	0.2
Beaver Dam	75	18	43.0	0.32	
Berea	70	19	44.2	0.57	T.
Blandville	70	25	47.1	0.29	
Bowling Green	74	20	45.0	1.40	
Burnside	68	22	44.4	2.57	T.
Cadiz	75	21	46.8	0.79	
Calhoun	75	22	46.6	0.47	
Catlettsburg	70	21	44.4	0.14	T.
Earlington	74	21	44.6	0.34	
Edmonton	73	17	44.3	1.34	
Eubank	70	17	41.9	1.65	T.
Falmouth				0.75	T.
Frankfort	68	21	44.4	0.73	
Greensburg	74	18	41.1	1.06	
Highbridge	71[i]	21[i]	43.4[i]	0.63	T.
Hopkinsville	79	20	45.7	0.74	
Irvington	76	24	45.6	0.53	
Jackson	73	22	46.4	1.36	1.0
Leitchfield	72	20	45.0	0.40	
Loretto	72	20	45.4	1.02	
Manchester	70	18	43.8	3.05	
Mayfield	70[a]	23[i]	45.7[h]	0.57	
Maysville	75	20	43.6	0.50	
Middlesboro	70[f]	20[f]	44.1[f]	3.56	
Mount Sterling	66	22	42.8	0.31	T.
Owensboro	74	24	45.6	0.23	
Owenton	69[e]	20[e]	45.8[e]	0.44	T.
Paducah *b*	75	27	49.0	0.20	
Princeton	74	19	46.5	0.30	
Richmond	69	18	44.4	0.40	
St. John	71	19	43.0	0.57	
Scott	71	18	43.8	0.51	T.
Shelby City	73	18	43.4	1.00	T.
Shelbyville	69	20	42.6	0.39	
Taylorsville	69	17	42.6	0.47	
Williamsburg	74	20	46.8	2.10	T.
Williamstown	70	17	45.2	0.63	
Louisiana.					
Abbeville	80	32	59.2	1.68	
Alexandria	81	28	55.5	3.36	
Amite	81	26	56.1	1.80	
Baton Rouge	84	32	58.6	1.60	
Burnside	78	28	57.8	0.36	
Cameron	79[j]	33	59.6[e]	2.89	
Caspiana	82	26	56.2	1.77	
Cheneyville	77	28	55.2	2.30	
Clinton	79	26	56.1	1.07	
Collinston	76	28	52.4	6.20	
Covington	77	28	54.6	1.13	
Donaldsonville		31		0.37	
Emilie	77	33	58.0	0.05	
Farmerville				5.19	
Franklin	84	33	59.4	0.87	
Georgetown	80	26	55.0	3.62	
Grand Coteau	79	29	58.0	1.88	
Hammond	77	27	55.8	0.94	
Houma	78	28	57.6	0.65	
Jennings	80	31	57.7	1.64	
Lafayette	79	30	58.4	1.58	
Lake Charles	85	30	56.1	3.05	
Lakeside	82	35	59.5	0.00	
Lawrence	81	35	61.2	1.44	
Leesville	84	25	55.5	2.50	
Libertyhill	82	24	56.0	2.00	
Logansport				1.55	
Mansfield	81	23	52.7	0.50	
Melville	80	27	56.0	2.20	
Minden	77	27	53.0	2.37	
Monroe	84	28	56.3	4.26	
New Iberia	79	34	60.2	1.25	
Opelousas	82	26	56.6	1.14	
Plain Dealing	83	20	53.7	1.52	
Port Eads	79	45	65.2	2.72	
Rayne	80	29	59.2	1.38	
Reserve	77	33	57.8	0.00	
Robeline	80	22	54.1	2.30	
Ruston	82	27	55.6	2.90	
St. Francisville	77[f]	35[h]	55.9[e]	5.01	
Schriever	85	28	58.0	0.64	
Southern University				1.22	
Sugar Experiment Station	76	37	59.8	1.50	
Sugartown	77	28	57.2	2.51	
Venice	78	34	60.5	3.01	
Maine.					
Bar Harbor	50	11	33.8	2.25	0.5
Chesuncook				1.57	13.2
Cornish	59	5	30.4	1.24	11.5
Danforth				2.35	1.5
Fairfield	52	4	30.0	1.61	7.0
Farmington	52	0	29.0	1.83	9.0
Gardiner	53	7	31.8	2.39	5.0
Grant Farm				1.31	8.0
Houlton	60	— 4	30.1	2.20	15.0
Lewiston	55	4	32.0	2.63	8.5
Madison				1.23	7.0
Mayfield	49	3	27.6	1.58	13.0
Maine—Cont'd.					
Millinocket	46	2	27.8	2.20	9.8
North Bridgton	62	5	31.6	1.33	8.5
Oquossoc	53	— 4	25.8	1.39	14.5
Orono	50	0	30.4	1.62	5.8
Patten	48	6	26.0	1.82	15.2
Rumford Falls	50	3	30.0	1.43	5.4
South Lagrange	50	— 2	28.4	1.92	6.9
The Forks				1.34	9.5
Vanburen	55	— 1	26.0	0.64	7.0
Vanceboro	48	0	27.8	1.49	11.0
Winslow	46	3	27.9	1.62	6.0
Maryland.					
Annapolis	68	23	43.0	2.15	T.
Bachmans Valley	61	17	39.0	1.88	12.0
Boettcherville	72	18	41.2	0.53	1.0
Cambridge	70	26	45.0	2.86	
Cheltenham	66	23	42.1	1.50	3.0
Chestertown	61	22	41.9	2.12	3.0
Chewsville	65	12	40.0	1.05	1.5
Clearspring	66	16	39.4	0.74	0.8
Coleman	64	22	43.4	1.91	2.0
Collegepark	68[e]	21[g]	43.1[f]		
Colora				2.43	4.1
Cumberland				0.55	1.0
Darlington	65	17	42.0	2.36	6.0
Deerpark	64[e]	12[e]	35.4[e]		
Denton	65	20	41.8	2.07	1.5
Easton	63	23	43.2	2.48	
Fallston	65	15	41.4	1.97	5.8
Frederick	70	16	43.5	1.51	
Grantsville	65	13	36.8	0.46	4.5
Greatfalls	67	18	40.7	1.15	
Greenspring Furnace	68	13	39.8	0.69	
Hancock	70	13	40.6	0.60	
Harney				1.42	1.0
Jewell	66	24	44.2	2.16	
Johns Hopkins Hospital	66	22	43.8	1.83	
Keedysville	69[e]	14[e]	41.2[e]	1.04	
Laurel	67	20	43.6	2.32	6.0
McDonogh		17		2.10	
Mount St. Marys College	66	17	42.2	1.31	
New Market	65	18	41.6	1.91	5.0
Oakland	64	11	36.1	0.82	5.0
Pocomoke City	66	27	44.8	1.82	
Princess Anne	69	21	42.9	1.59	1.0
Solomons	65	28	45.6	1.63	1.0
Takoma Park	66	20	41.4	1.06	6.0
Van Bibber	63	19[e]	41.4	2.21	
Westernport	65	19	40.0	0.29	0.5
Woodstock	64	20	43.0	1.86	2.0
Massachusetts.					
Bedford	57	9	35.1	1.69	2.0
Bluehill (summit)	58	9	35.4	1.90	2.2
Cambridge	59	11	36.2	1.80	
Chestnuthill	58	10	36.0	1.81	T.
Concord	58	6	33.5	1.52	4.9
East Templeton[e1]	50	8	32.4	0.83	6.0
Fall River	56	16	37.9	2.20	3.0
Fitchburg *b*	55	10	35.2	0.73	5.5
Framingham	58	6	35.1	1.73	2.0
Groton	54	8	32.6	1.03	5.0
Hyannis				2.42	2.5
Jefferson				1.58	6.5
Lawrence	56	8	34.8	1.35	1.5
Leominster				1.27	6.3
Lowell *a*	55	12	35.9	1.51	
Lowell *b*	59	7	35.1		
Ludlow Center	50	3	29.8	1.15	2.0
Middleboro	57	4	35.5	2.13	0.6
Monson	56	7	33.4	1.86	6.0
New Bedford	55	10	36.5	2.29	2.0
Pittsfield				1.50	8.0
Plymouth[e1]	56	20	38.4	3.53	T.
Princeton				1.09	7.0
Provincetown	60	24	41.9	3.10	1.5
Salem				1.80	T.
Somerset	58	12	36.6	2.56	4.0
Sterling				1.00	4.8
Taunton	57	4	34.4	2.05	0.1
Webster				1.26	2.8
Westboro	58	7	35.1	1.80	2.5
Weston	57	7	34.0	1.53	0.7
Williamstown	52	7	32.0	1.68	5.8
Winchendon				1.24	10.0
Worcester	58	12	35.8	0.81	4.6
Michigan.					
Adrian	70	16	39.2	T.	T.
Agricultural College	69[e]	15[e]	40.0[e]	0.04	0.4
Allegan	68[f]	16[f]	38.6[f]	0.10	1.0
Alma	68	12	38.1	T.	T.
Ann Arbor	69	12	39.2	0.10	0.2
Arbela	65	8	38.0	0.27	T.
Baldwin	71	6	39.3	0.35	3.5
Ball Mountain	66	7	38.0	0.05	0.3
Baraga	70[e]	4[h]	36.3[e]	1.15	11.5
Battlecreek	69	19	38.6	0.08	T.
Bay City	64	9	38.1	0.17	0.5
Benzonia	62	14	38.0	0.76	2.7

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Berlin	65	5	37.4	0.38	3.5
Berrien Springs	69[d]	19[d]	41.2[d]	0.62	T.
Big Rapids	68	11	35.6	T.	T.
Birmingham	67	19	38.4	0.00	
Bloomingdale	69	19	40.6	0.25	3.5
Calumet	60	11	36.5	1.46	15.1
Cassopolis	71	20	40.4	0.10	T.
Charlevoix	.....	.....	.....	0.15	1.5
Chatham	69	2	35.7	0.98	7.5
Cheyboygan	71	13	36.7	1.07	4.0
Clinton	70	10	39.7	T.	.....
Coldwater	71	18	41.8	0.10	1.0
Deer Park	57	12	35.2	1.59	15.0
Detour	56	9	35.8	1.00	7.5
Dundee	70	12	40.1	0.05	0.5
Eagle Harbor	61	11	36.8	0.85	7.0
East Tawas	56	6	35.4	0.14	T.
Eloise	68	8	38.4	T.	T.
Ewen	65	7	34.0	0.47	4.5
Fitchburg	67	11	36.6	0.28	1.5
Flint	66	6	37.4	0.25	0.5
Frankfort [b]	60	5	37.9	0.26	2.5
Gaylord	.....	12	.....	0.86	8.6
Gladwin	69	−4	35.6	0.05	0.5
Grand Haven	61	21	40.6	T.	T.
Grand Marais	59[f]	8	36.3[e]	0.76	11.5
Grape	69	11	39.0	0.02	0.5
Grayling	63	−3	33.5	0.85	9.0
Hagar	66	16	39.7	0.23	T.
Harbor Beach	66	10	38.9	0.09	0.4
Harrison	68	4	36.6	T.	T.
Harrisville	66	8	35.7	0.52	2.0
Hayes	65	9	38.1	T.	
Highland	.....	.....	.....	0.33	T.
Hillsdale	67	19	38.7	0.07	T.
Howell	68	8	36.6	0.10	T.
Humboldt	.....	.....	.....	1.20	12.0
Iron Mountain	70	4	34.8	0.02	0.3
Iron River	70	0	33.4	0.80	10.0
Ironwood	69	3	35.2	1.15	11.5
Ishpeming	69	2	33.4	1.79	17.3
Ivan	67	−4	33.6	0.89	10.0
Jackson	69	18	39.7	0.07	T.
Jeddo	64	8	37.9	0.24	0.7
Kalamazoo	68	17	39.2	0.50	5.0
Lake City	.....	18	.....	1.10	1.5
Lansing	68	17	39.7	0.07	0.1
Ludington	60[e]	23	42.8[e]	T.	
Mackinac Island	57	12	36.2	1.20	6.5
Mackinaw City	63	14	35.3	0.45	4.5
Mancelona	66	−2[e]	34.0[e]	0.28	1.5
Manistee	.....	.....	.....	0.40	4.0
Marine City	.....	.....	.....	0.28	2.8
Menominee	66	10	38.6	0.20	T.
Midland	.....	.....	.....	0.10	T.
Montague	68	20	40.8	0.35	3.5
Muskegon	70	20	41.6	0.04	T.
Newberry	60	6	34.0	0.50	5.0
Old Mission	65	.....	.....	0.70	2.0
Olivet	64	19	38.8	0.02	0.2
Onaway	65	10	35.8	.....	
Ovid	67	12	38.8	0.00	
Owosso	.....	.....	.....	.....	T.
Petoskey	65	15	38.6	0.50	5.0
Plymouth	70	7[j]	38.6[e]	.....	
Powers	.....	.....	.....	0.40	4.0
Reed City	67	12	37.2	0.21	1.6
Roscommon	65	−6	32.8	0.70	4.0
Saginaw (W. S.)	66	8	38.2	0.15	0.2
St. Ignace	58	6	37.6	0.40	4.0
St. Johns	70	16	41.4	0.07	0.5
St. Joseph	.....	.....	.....	0.02	T.
Slocum	68	19	38.2	T.	T.
South Haven	67	19	40.0	0.22	T.
Stanton	70	10	37.2	0.01	0.1
Thomaston	67	5	34.0	0.71	7.0
Thornville	65	14	38.9	0.60	2.0
Traverse City	65	8	38.6	1.07	3.5
Vassar	72	4	40.7	0.41	0.6
Wasepi	68	18	39.3	0.01	T.
Webberville	68	10	38.0	0.12	T.
West Branch	.....	.....	.....	0.30	3.0
Wetmore	62	.....	.....	1.21	12.1
Whitefish Point	55	15	36.1	1.14	13.8
Ypsilanti	65	17	37.1	0.09	0.5
Minnesota.					
Albert Lea	68	8	38.8	0.21	T.
Alexandria	74	3	35.5	T.	T.
Angus	67	−7	33.8	T.	T.
Ashby	65	4	36.3	0.03	T.
Bemidji	66	1	38.0	0.31	3.1
Bird Island	72	10	38.8	0.14	T.
Caledonia	65	6	37.1	0.31	
Collegeville	66	8	37.8	0.07	0.2
Crookston	63	2	33.2	0.10	1.0
Currie	75[b]	13[e]	38.6[e]	.....	
Deephaven	.....	.....	.....	0.15	
Detroit City	75	−5	32.8	T.	T.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Minnesota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Faribault	70	5	37.6	0.18	0.3
Farmington	69	7	37.9	0.23	2.0
Fergus Falls	65	4	34.6	T.	T.
Floodwood	69	−8	34.8	0.10	1.0
Glencoe	70	7	38.1	0.10	1.0
Grand Meadow	71	6	38.8	0.21	0.5
Hallock	67	−14	32.2	0.32	3.0
Lake Winnibigoshish	64	5	33.5	0.27	3.2
Leech	67	0	34.0	0.15	3.3
Long Prairie	71	4	36.2	0.25	0.1
Luverne	65	8	37.4	T.	T.
Lynd	68	8	37.6	0.06	1.0
Mankato	.....	.....	.....	0.18	T.
Mapleplain	69	8	37.6	0.12	0.8
Milaca	70	5	35.6	0.10	2.0
Milan	73	5	37.2	T.	T.
Minneapolis [1]	68*	9	36.0	0.12	T.
Montevideo	69	7	37.8	0.07	T.
Mora	70	4	35.8	0.05	T.
Morris	68	5	35.6	0.01	0.1
Mount Iron	66	−8[d]	33.0[b]	0.60	6.0
New London	70	4	36.0	0.05	
New Richland	75	15	40.4	T.	
New Ulm	73	9	38.6	0.33	1.0
Park Rapids	66	−2	33.8	0.17	1.3
Pine River	67	6	34.6	0.14	3.0
Pleasant Mounds	73	6	40.2	0.22	1.0
Pokegama Falls	71	−12	29.7	0.36	5.0
Redwing *a*	78	10	39.8	0.01	T.
Reeds	.....	.....	.....	0.00	
Rolling Green	68	11	38.4	0.30	2.0
St. Charles	67	8	38.5	0.21	
St. Cloud	69	3	39.0	0.08	T.
St. Peter	72	8	38.8	T.	T.
Sandy Lake Dam	69	−2	34.4	0.21	2.4
Shakopee	55	9	34.4	0.12	
Wabasha	77	10	39.9	0.28	T.
Wadena	69	3	35.6	0.05	0.8
Winnebago	74	8	38.6	0.30	1.1
Winona	68	12	39.0	0.26	T.
Worthington	71	15	43.2	T.	T.
Zumbrota	66	6	37.6	T.	T.
Mississippi.					
Aberdeen	75	25	48.9	2.97	
Batesville	76	22	48.8	2.40	
Bay St. Louis	79	34	58.2	3.29	
Biloxi	75	38[d]	58.7[e]	2.68	
Booneville	72	26	49.4	2.76	
Brookhaven	81	29	53.4	2.42	
Canton	78	24	53.6	2.97	
Columbus	74	26	49.6	4.79	
Corinth	72	27	49.0	2.61	
Crystal Springs	86	31	56.8	2.97	
Duck Hill	78	24	49.4	2.13	
Edwards	79	26	54.4	2.45	
Fayette	79	27	54.2	1.95	
Fayette (near)	.....	.....	.....	1.88	
Greenville *a*	75	26	52.2	3.32	
Greenville *b*	79	28	53.6	3.47	
Greenwood	78	24	51.0	3.55	
Hattiesburg	.....	.....	.....	T.	
Hazlehurst	80	30	56.4	3.20	
Hernando	77	29	52.6	1.75	
Holly Springs	72	30	50.8	1.74	
Jackson	78	26	52.8	3.26	
Kosciusko	79	25	53.3	4.47	
Lake	78	24	51.2	2.89	
Lake Como	81	27	51.6	2.81	
Laurel	79	27	54.2	2.85	
Leakesville	80	27	55.6	2.14	
Louisville	76	27	53.4	3.33	T.
Magnolia	84	28	58.1	1.17	
Natchez	81	34	60.8	2.40	
Nitta Yuma	76	27	52.6	8.59	
Okolona	73	23	50.2	0.60	
Patmos	.....	.....	.....	2.77	
Pearlington	76[e]	32[e]	56.8[e]	2.01	
Pecan	79	36[e]	61.0	2.92	
Pittsboro	75	24	50.8	2.90	
Pontotoc	72	28	51.0	2.91	
Poplarville	77	31	57.0	1.72	
Port Gibson	87	25	54.8	2.59	
Shelby	84	21	52.6	2.32	
Shoccoe	78	25	53.4	3.04	
Stonington	.....	.....	.....	1.59	
Suffolk	79	27	55.5	2.18	
Tchula	82	23	53.3	1.20	
Tupelo	80[b]	23[b]	51.7[b]	3.19	
University	78	28	52.9	2.94	
Walnutgrove	76[d]	25[d]	53.0[d]	3.81	
Watervalley	77	25	52.0	3.46	
Waynesboro	78	25	54.4	3.65	
Woodville	77	32	56.8	1.34	
Yazoo City	79	26	53.3	3.40	
Missouri.					
Appleton City	77	18	47.8	0.41	
Arthur	81	15	48.2	0.18	
Avalon	76	15	46.2	0.13	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bethany	69	12	41.0	T.	
Birchtree	75[d]	25[d]	49.2[d]	T.	
Blue Springs	75	19	45.8	0.25	T.
Boonville	.....	.....	.....	0.49	
Brunswick	76	20	45.0	0.26	
Carrollton	74[d]	16[d]	46.4[d]	0.04	
Caruthersville	76	19	48.3	T.	
Conception	73	16	45.2	0.06	
Darksville	73	12	46.2	0.20	
Dean	78	20	49.4	0.10	
Desoto	77	23	48.2	0.89	
Doniphan	75	19	46.9	0.00	
Downing	.....	.....	.....	0.10	
Fairport	.....	.....	.....	0.07	
Fayette	75	17	44.9	0.38	
Fulton	75	15	44.4	0.10	
Gallatin *[i]	76	20	46.1	0.03	
Gano	77	22	48.3	0.30	
Glasgow	74	20	46.2	0.35	
Gorin	.....	.....	.....	0.25	
Grant City	74	13	44.7	0.05	
Harrisonville	75	12	44.5	0.26	
Hazlehurst	.....	.....	.....	T.	
Houston	75	15	45.3	0.17	
Ironton	75	16	43.8	0.20	
Jackson	75	19	46.7	0.15	
Jefferson City	76	19	46.2	0.17	
Joplin	78	24	51.2	0.18	T.
Kidder	74	16	45.3	0.07	
Koshkonong	76	24	50.5	T.	
Lamar	78	18	49.7	T.	T.
Lamonte	.....	.....	.....	0.25	T.
Lebanon	74	20	47.8	0.37	
Lexington	83	20	47.4	0.15	
Liberty	73	19	47.2	0.12	T.
Lockwood	75	20	48.8	0.14	T.
Louisiana	75	16	12.4	0.28	
Macon	74	16	46.4	0.18	
Marblehill	77	19	47.3	0.12	
Marshall	76	17	46.0	0.18	
Maryville	72	15	42.5	T.	T.
Mexico	75	17	45.3	0.24	
Miami *[k]	73	20	45.6	0.60	
Montreal	78	15	46.3	0.29	T.
Mountaingrove	73	18	47.6	0.15	T.
Mount Vernon	76	16	48.8	0.28	T.
Neosho	77	17	47.9	0.23	T.
Nevada	.....	.....	.....	0.22	T.
New Haven	77	23	46.4	0.77	
New Madrid	.....	.....	.....	0.17	
New Palestine	75	21	47.8	0.39	
Oakfield	77	23	48.2	0.68	
Olden	77	15	48.5	0.05	
Oregon	73	17	44.7	0.25	0.5
Pine Hill	.....	.....	.....	0.28	
Princeton	71	14	45.4	0.15	
Rockport	.....	.....	.....	0.03	
Rolla	.....	.....	.....	0.28	
St. Charles	74	18	46.4	0.60	
St. Joseph	.....	.....	.....	T.	T.
Sarcoxie	.....	.....	.....	0.38	T.
Sedalia	74	20	47.4	0.40	
Seymour	74	19	48.1	0.29	
Sikeston	73	21	47.6	0.14	
Steffenville	75	14	44.5	0.07	
Sublett	73	11	43.8	0.00	
Trenton	71	18	44.6	T.	
Unionville	74	12	44.2	T.	
Versailles	76	20	47.8	0.23	
Warrensburg	78	20	49.4	0.04	
Warrenton	74	19	45.0	0.38	
Warsaw	78	13	44.4	0.27	
Wheatland	.....	.....	.....	0.37	
Willowsprings	74	14	46.0	0.60	
Windsor	77[e]	17[e]	45.7[e]	0.06	
Zeitonia	76	12	44.5	0.00	
Montana.					
Adel	64	7	40.1	0.05	0.5
Anaconda	68	19	40.6	T.	0.1
Augusta	74	10	43.0	T.	T.
Boulder	60	12	37.0	0.17	T.
Bozeman	60	16	39.0	0.37	2.0
Butte	58	20	40.7	0.12	
Canyon Ferry	61	15	38.1	0.01	T.
Cascade	66	11	47.6	0.02	
Chester	62	3	35.0	0.00	
Columbia Falls	59	16	37.4	0.56	T.
Crow Agency	69	9	40.0	0.40	
Culbertson	71	−7	35.0	T.	T.
Dayton	58	11	37.2	T.	
Decker	74	3	37.2	0.05	0.5
Deerlodge	59	12	36.7	.....	
Dillon	62	16	40.2	0.02	T.
Fallon	69[d]	4	37.2[b]	0.00	
Forsyth	71	5	39.4	0.10	
Fort Harrison	67	9	39.4	.....	
Glasgow	69[b]	9[b]	37.8[b]	.....	
Glendive	76	−2	35.1	0.00	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Montana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Grayling	57	— 3	28.4	T.	T.
Greatfalls	65	17	45.8	0.01	
Hamilton	60	21	40.8	0.40	
Livingston	67	11	46.2	0.09	T.
Lewistown	73	11	42.8	0.05	0.5
Lodgegrass	70	6	39.6	0.25	T.
Marysville	57	19	38.2	0.80	T.
Missoula	65	22	40.1	0.12	
Ovando	58	11	34.8	0.32	T.
Parrot	62	16	41.8	T.	
Philipsburg	72	13	41.6	0.01	
Plains	60	20	39.6	T.	
Poplar	71	0	37.4	0.00	
Redlodge	65	8	40.3	0.12	2.0
Ridgelawn	72	10	38.6	0.00	
St. Pauls	80	18	46.6	0.01	T.
St. Peter	59	20	44.4	0.10	1.0
Saltese				2.11	4.0
Springbrook	70	5	40.2	T.	T.
Toston	69	14	38.8	0.03	
Troy	59	24	39.9	3.86	
Twin Bridges	65	11	38.4	0.00	
Utica	72	14	45.2	0.50	3.0
Wolf Creek	61	18	42.2	0.08	
Yale	63	4	37.8	0.05	
Nebraska.					
Agate	69	0	38.0	0.01	T.
Agee *1	74	6	38.8	0.30	1.0
Alliance	72	12	39.7	0.00	
Alma	76	14	43.0	0.05	0.5
Ansley	70	8	40.6	0.10	1.0
Arapaho				0.00	
Arcadia				T.	T.
Ashland *a*	73	15	43.6	0.27	1.0
Auburn	76	16	44.3	0.36	1.0
Aurora	72	19	44.8	0.05	0.5
Bartley	74	8	41.8	0.09	
Beatrice	74	20	45.6	0.39	1.5
Beaver	73	10	43.8	0.10	T.
Bellevue				0.21	1.0
Benkleman				T.	T.
Bethany				0.48	3.0
Blair	71	15	42.8	0.10	2.0
Bluehill				0.05	0.5
Bradshaw				0.32	
Bridgeport	72	0	39.0	T.	T.
Broken Bow	74	7	41.6	T.	T.
Burchard				0.23	0.1
Burge				0.19	0.2
Burwell				0.05	0.5
Central City				0.20	1.5
Chester				0.20	2.0
Cody				0.05	0.5
Columbus	77	15	42.0	0.09	0.5
Crete	72	20	44.5	0.20	2.0
Culbertson	79	14	43.9	0.05	T.
Curtis	69	9	40.8	T.	T.
David City	71	15	43.3	0.24	2.2
Dawson	76	19	45.8	0.35	
Duff				0.10	1.0
Edgar				0.10	1.0
Ericson				0.30	2.0
Ewing				0.05	0.5
Fairbury	76	16	43.0	0.21	2.0
Fairmont	72	19	42.6	0.10	0.5
Fort Robinson	70	10	41.0	T.	T.
Franklin	76	10	42.8	0.02	0.2
Fremont	73	12	42.2	0.20	1.2
Fullerton				0.10	0.8
Geneva	74	20	45.2	0.29	2.0
Genoa (near)	70	18	42.8	0.11	2.5
Gering	72	5	41.8	0.01	
Gordon				0.25	1.0
Gothenburg	74	9	43.0	0.12	
Grand Island *a*	78	18	43.2	0.20	1.5
Greeley				T.	T.
Guide Rock				0.15	1.0
Haigler				0.02	
Halsey	75	7	42.0	0.12	T.
Hartington				0.10	1.0
Harvard	69	18	41.6	0.05	T.
Hastings *1	71	19	42.9	0.12	1.8
Hayes Center				0.07	1.0
Hebron	76	17	43.4	0.23	2.0
Hickman				0.20	2.0
Holbrook				0.01	T.
Holdrege	75	18	45.0	0.10	1.0
Holly				0.10	1.0
Hooper *1	70	16	40.2	0.17	1.0
Imperial	74	7	40.5	0.10	T.
Johnstown				0.02	0.2
Kearney	73	18	44.6	0.19	3.6
Kennedy	76	5	42.0	0.05	2.0
Kimball	70	5	39.4	0.15	1.5
Kirkwood	78	5	42.9	0.10	T.
Leavitt	76	13	41.7	0.02	0.2
Lexington	72	10	41.6	0.05	0.5
Lockridge	72	17	43.2	0.18	0.5

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lodgepole	70*e*	7*e*	37.8*e*	T.	T.
Loup	73	14	42.0	T.	T.
McCook				T.	
McCool				0.19	
Madison	72	13	41.4	0.13	1.0
Marquette				0.20	2.0
Mason				0.00	
Merriman				0.10	1.0
Minden	72	17	42.8	0.11	1.0
Nebraska City	73	14	42.9	0.20	1.0
Nemaha				0.10	T.
Norfolk	77	9	41.2	0.12	3.0
North Loup	77	12	41.8	0.05	0.5
Oakdale	74	13	40.2	0.15	0.5
Odell				T.	T.
O'Neill	77	8	42.8	0.05	0.5
Ord				0.00	
Osceola				0.25	
Palmer				0.30	3.0
Palmyra *1	76	18	42.4	0.41	2.0
Pawnee City	76	16	43.6	0.30	1.0
Plattsmouth *b*		11		0.08	0.8
Purdum	78	5	41.0	0.04	T.
Ravenna *a*	74	18	42.9	0.12	0.9
Redcloud	74	15	42.5	0.05	0.5
Republican				0.00	
St. Libory				0.10	2.5
St. Paul	75	18	43.3	0.10	0.6
Santee	81	12	42.5	0.38	T.
Schuyler				0.20	2.0
Seneca				0.01	0.1
Seward	72	15	41.6	0.40	4.0
Smithfield				0.00	
Springview	74	9	43.5	T.	T.
Stanton	76	10	41.4	0.17	1.5
Strang				0.10	1.0
Stratton				0.02	
Stromsburg				0.10	
Superior	70	18	41.4	T.	T.
Syracuse				0.20	2.0
Tablerock				0.40	2.0
Tecumseh *b*	75	14	42.3	0.09	1.0
Tecumseh *c*				0.15	1.0
Tekamah	74	13	42.6	0.28	3.0
Turlington	73	17	44.5	0.18	2.5
University Farm	73	14	44.5	0.18	0.5
Wahoo				0.15	1.0
Wakefield	74	4	40.1	0.35	2.5
Wallace				0.00	
Wauneta				0.00	
Weeping Water				0.38	3.0
Westpoint	74	14	42.8	0.19	1.2
Whitman				0.02	0.2
Wilber				0.10	1.0
Wilsonville				0.08	
Winnebago	72	3	39.5	0.21	1.5
Wisner				0.50	4.5
Wymore				0.00	
York	72			0.30	0.8
Nevada.					
Amos	68	12	38.8	0.02	
Austin	69*e*	22*e*	45.2*e*	T.	
Battle Mountain	78	16	46.2	T.	
Belmont	59	14	40.0	0.00	
Beowawe *1	65	23	41.1	0.00	
Caliente	79	14	46.0	0.00	
Candelaria	65	28	45.6	0.31	T.
Carlin *1	60	12	36.5	0.00	
Carson City	67	14	41.5	0.01	
Cranes Ranch				T.	
Dyer	66	9	39.3	0.00	
Eureka	72	19	45.4		
Geyser	67*d*	6*d*	37.1*d*	0.00	
Golconda				0.05	
Halleck *b*	60	8	32.9	0.00	
Hawthorne	70	24	44.8	0.60	
Humboldt	65	20	44.4	T.	
Lewers Ranch	68	22	46.6	0.68	
Lovelocks	70	23	42.6	T.	
Martins	78	16	45.8	0.00	
Mill City *1	60	33	42.8	0.00	
Palisade	68	13	41.7	0.00	
Palmetto	65	15	40.1	0.20	2.0
Pioche	69	11	40.2	0.00	
Potts	59	10	36.9	0.00	
Reno State University	67	20	43.0	T.	
San Jacinto	63	9	36.6	T.	
Sodaville	80	30	53.4	0.22	
Tecoma				0.00	
Toano				0.00	
Wabuska	77	15	42.4	0.00	
Wadsworth	74	16	42.4	0.00	
Wells *1	60	18	35.6	0.00	
Wood	64*h*	11*h*	38.3*h*	T.	
New Hampshire.					
Bartlett				0.65	6.5
Berlin Mills	50	— 7	24.8	1.68	11.5
Bethlehem	50	0	26.8	1.66	16.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New Hampshire—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bretton Woods				2.30	23.0
Brookline *1	55	4	32.0	0.84	4.2
Chatham	54	— 1	27.6	0.80	6.0
Durham	58	4	33.4	1.12	
Franklin Falls	54	4	31.0	1.55	4.2
Grafton	48	— 4	27.2	1.25	6.0
Hanover	56	— 1	29.0	0.93	7.0
Keene	54	— 3	30.2	1.91	10.0
Nashua	55	6	32.8	1.45	7.2
Newton	55	3	33.2	1.61	2.0
Plymouth	50	4	29.8	0.84	1.5
Stratford	49	— 3	26.6	0.98	9.0
New Jersey.					
Asbury Park	64	19	42.0	2.03	T.
Bayonne	62	19	40.4	2.52	0.5
Belvidere	61	14	38.6	2.19	4.5
Bergen Point	62	17	40.2	2.64	0.5
Beverly	66	17	41.6	2.23	2.2
Blairstown	59	13	37.6	1.80	
Bridgeton	69	20	43.2	2.25	
Canton				1.91	
Cape May C. H	66	19	42.6	1.48	T.
Charlotteburg	59	6	36.2	1.78	3.2
Chester	60	13	37.7	1.26	9.5
Clayton	65	15	40.2	2.38	T.
College Farm	61	15	39.7	2.70	0.4
Dover	59	11	36.2	2.10	5.0
Elizabeth				2.85	1.0
Englewood	59	19	37.9	3.40	0.5
Flemington	63	15	39.6	2.33	0.5
Friesburg	65	19	41.6	2.14	2.1
Hightstown	62	19	40.2	2.72	T.
Imlaystown	63	19	41.7	1.92	0.2
Indian Mills	68	13	41.2	2.05	1.0
Lakewood	64	14	41.0	1.91	T.
Lambertville	62	17	40.0	2.55	1.0
Layton	61	8	35.1	1.75	5.0
Moorestown	63	18	40.9	2.04	8.6
Newark	60	17	39.8	1.85	0.1
New Brunswick	64	19	40.9	2.72	0.8
Oceanic	62	17	41.8	1.90	0.5
Paterson	63	18	41.2	1.69	0.5
Phillipsburg	60	16	38.8	1.96	4.0
Plainfield	61	15	39.1	2.27	0.6
Pleasantville				2.23	T.
Rancocas				2.42	1.8
Rivervale	58	9	35.9	2.50	2.0
Sandy Hook	61	20	41.7	2.24	0.4
Somerville	63	15	39.0	2.49	0.5
South Orange	59	16	39.1	1.30	T.
Sussex	57	13	37.5	2.09	6.0
Trenton	63	24	43.8	2.10	T.
Tuckerton	72	11	40.4	2.33	0.8
Vineland	68	17	41.0	2.10	1.5
Woodbine				1.70	T.
Woodstown				1.91	2.0
New Mexico.					
Alamagordo	74			0.17	T.
Albert	75	21	49.5*f*	0.00	
Albuquerque	70	12	42.6	0.00	
Arabela	84	5	44.6	0.33	6.0
Bellranch	75	14	45.8	T.	T.
Bloomfield	72	14	40.2	0.00	
Cambray				0.50	
Carlsbad	86*j*	21*j*	53.7*j*	0.96	
Cimarron	73	6	42.6	0.19	0.5
Cloudcroft	57	—5	33.2	0.55	8.0
Deming	77	19	46.2	0.64	
Eagle Rock Ranch	66	2	37.6	0.10	1.0
Elk	75	7	45.2	0.34	1.0
Engle	69	16	44.7	0.00	
Fort Bayard	70	15	45.6	0.31	
Fort Stanton	67	6	40.9	0.08	0.8
Fort Union	78	2	43.9	0.27	2.0
Fort Wingate	68	10	41.8	0.00	
Fruitland	64	—1	36.2	0.00	
Hillsboro	69	22	47.5	T.	T.
Las Vegas	72	2	40.7	0.05	0.5
Lordsburg				0.55	
Los Lunas	64	20	43.2	0.00	
Luna	64	10	37.0	0.00	
Mesilla Park	74	17	47.6	0.50	
Mineral Hill				0.12	3.0
Mountainair	63	—1	40.0	0.03	1.0
Raton	66	6	40.9	0.05	0.5
Roclada	71	5	41.2	0.34	6.5
Roswell	77°	21	48.0*b*	0.15	T.
San Marcial	76	20	45.9	0.00	
San Rafael	72	9	40.2	0.00	
Socorro	63	20	43.6	0.06	T.
Springer	69	8	39.4	0.00	
Strauss				0.58	
Taos	67	4	40.2	0.21	3.0
Vermejo	69	—6	38.0	0.20	2.5
New York.					
Adams				1.10	9.5
Addison	67	4	36.8	0.56	2.0
Akron				0.78	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Alden	61	6	37.3	0.94	5.8
Ames	64	10	33.4	0.70	5.7
Amsterdam	54	7	33.0	0.49	4.0
Appleton	60	16	37.1	0.17	0.7
Arcade	62	−12	34.5	0.58	1.5
Athens	57	12	35.1	1.24	4.2
Atlanta	63	8	35.8	0.98	.....
Atwater	.....	.....	.....	0.92	5.3
Auburn	63	11	36.3	0.82	4.0
Avon	63	6	35.8	0.39	4.0
Baldwinsville	61	9	35.1	1.01	6.5
Ballston Lake	54	7	32.4	0.70	5.0
Bedford	57	10	37.6	1.90	2.3
Berlin	57	−3	31.4	1.80	18.0
Blue Mountain Lake	.....	.....	.....	0.51	5.5
Bolivar	64	−5	34.9	0.83	11.5
Bouckville	55	3	33.2	1.11	8.0
Boyds Corners	.....	.....	.....	1.78	.....
Brockport	63	10	37.8	0.35	2.1
Cape Vincent	55	6	34.2	0.65	.....
Carmel	54	14	34.6	2.04	5.5
Carvers Falls	53	0	29.0	0.65	6.0
Chatham	55	8	33.4	2.01	12.0
Chazy	56	2	30.1	0.30	1.5
Cold Spring Harbor	.....	.....	.....	2.31	0.2
Cooperstown	53	2	30.9	1.18	7.2
Cortland	60	5	34.8	0.84	2.0
Cutchogue	62	15	39.5	2.05	T.
Deansboro	.....	.....	.....	0.70	6.0
Dekalb Junction	57	0	31.4	0.87	4.5
De Ruyter	60	−1	32.8	1.96	14.4
Easton	.....	.....	.....	0.86	9.0
Elba	62	12	37.0	0.66	3.0
Elmira	65	12	37.7	0.57	.....
Faust	54	0	28.6	0.55	5.5
Fayetteville	66	5	35.4	0.53	4.0
Fort Plain	58	9	34.8	0.46	2.5
Franklinville	63	−2	34.8	1.77	10.7
Gabriels	56	−12	26.6	1.31	.....
Gansevoort	.....	.....	.....	0.75	2.5
Glens Falls	53	4	31.8	0.62	3.0
Gloversville	54	6	31.8	0.38	3.0
Greenwich	54	4	31.4	0.73	3.5
Griffin Corners	55	−1	30.4	2.12	19.0
Harkness	57	4	30.4	0.29	2.5
Haskinville	.....	.....	.....	0.53	4.5
Hemlock	61	14	37.6	0.31	3.2
Homer	60	2	32.6	1.00	8.7
Hunt	65	−2	35.3	0.80	2.4
Indian Lake	59	−3	28.8	0.45	4.7
Ithaca	63	9	36.0	0.84	5.9
Jamestown	66	−5	35.8	1.31	8.4
Jeffersonville	59	7	34.0	1.32	12.0
Keene Valley	63	−1	29.4	0.35	6.5
Lake George	53	7	32.3	0.75	0.7
Lenox	.....	.....	.....	0.62	.....
Le Roy	65	11	37.4	0.62	3.6
Liberty	59	2	32.4	1.41	11.2
Littlefalls, City Res.	57	7	32.8	0.35	3.5
Lockport	63	16	37.6	0.21	T.
Lowville	58	−3	30.2	0.21	1.6
Lyndonville	.....	.....	.....	0.14	1.4
Lyons	65	10	37.5	1.49	11.0
Middletown	57	16	37.2	1.50	9.6
Mohonk Lake	53	12	34.9	1.27	10.5
Moira	60	−2	30.5	1.19	8.0
Newark Valley	.....	.....	.....	0.59	6.5
New Lisbon	55	−2	28.9	1.86	17.5
North Hammond	56	4	32.4	0.32	2.7
Number Four	.....	.....	.....	0.38	3.2
Ogdensburg	58	2	31.5	0.49	2.4
Old Chatham	.....	.....	.....	1.64	8.4
Oneonta	58	6	33.4	2.07	16.5
Oswegatchie	.....	.....	.....	0.16	1.5
Otto	.....	.....	.....	0.63	5.9
Oxford	55[a]	4	32.5[b]	1.50	11.5
Oyster Bay	59	19	39.4	2.20	0.2
Palermo	.....	.....	.....	0.68	3.9
Perry City	60	2	33.6	1.07	8.3
Plattsburg Barracks	59	7	32.2	T.	T.
Port Jervis	59	12	36.0	2.28	5.0
Potsdam	58	−3	31.4	0.61	5.0
Primrose	61	12	38.0	2.79	2.0
Redhook	.....	.....	.....	2.05	1.2
Richland	60	8	33.8	0.80	3.0
Richmondville	56	4[i]	34.8[c]	1.26	9.5
Ridgeway	62	15	37.4	0.49	2.0
Ripley	67	19	39.8	0.40	2.0
Rome	59	12	35.2	0.72	4.0
Romulus	64	12	37.4	0.32	1.0
Salisbury Mills	.....	.....	.....	2.03	2.0
Saranac	54	−5	29.0	0.46	4.4
Saratoga Springs	56	7	33.0	0.40	4.0
Scarsdale	58	12	36.6	1.54	1.0
Scottsville	.....	.....	.....	0.33	.....
Setauket	59	18	40.4	2.08	0.1
Shortsville	64	12	36.7	0.40	2.8
Skaneateles	.....	.....	.....	1.31	.....
Southampton	58	20	39.3	2.78	0.2
South Butler	.....	.....	.....	0.79	5.0
South Canisteo	64	−2	35.7	1.05	8.5
Southeast Reservoir	.....	.....	.....	1.98	.....
South Kortright	55	−4	30.3	1.98	21.4
South Schroon	53	−1	28.6	0.40	3.8
Spier Falls	54	9	31.8	0.26	2.0
Straits Corners	64[e]	5[e]	33.6[e]	0.30	2.0
Ticonderoga	54	8	32.3	0.29	2.5
Volusia	64	17	37.2	1.07	7.0
Wappinger Falls	58	14	35.2	2.06	10.5
Warwick	.....	.....	.....	1.25	7.0
Watertown	58	4	33.1	0.82	5.0
Waverly	64	13	35.4	0.69	3.1
Wedgwood	61	7	34.2	0.62	6.5
Wells	56	2	31.0	0.24	2.0
West Berne	58	0	33.0	0.45	.....
Westfield	65	19	38.8	0.71	4.0
Windham	56	0	32.0	2.41	23.5
Youngstown	.....	.....	.....	0.25	T.
North Carolina.					
Brevard	77	15	44.9	2.11	T.
Brewers	75	17	45.6	3.60	1.0
Bryson City	.....	.....	.....	3.49	1.0
Currituck	.....	.....	.....	1.71	
Eagletown	69	26	45.6	3.83	T.
Edenton	69	27	47.6	2.35	
Fayetteville	74	26	50.4	4.17	
Goldsboro	69	28	48.4	3.02	
Graham	.....	.....	.....	3.35	T.
Greensboro	74	23	48.4	2.6	
Henderson	68	27	47.2	4.55	0.5
Hendersonville	69	19	44.6	3.20	3.0
Henrietta	73	22	48.4	4.10	T.
Horse Cove	67	24	46.4	4.49	0.6
Hot Springs	71	25	48.7	.....	3.0
Jefferson[d]	64	12	41.8	2.92	2.1
Kinston	72	24	48.6	2.30	
Lenoir	73[j]	19[j]	48.0[j]	.....	.....
Lexington	72	21	46.3	3.17	
Lincolnton	74	25	47.8	.....	
Linville	61	15	38.2	3.40	1.0
Littleton	68	25	44.4	4.05	T.
Louisburg	67	26	47.0	4.03	T.
Lumberton	74	25	49.2	2.35	T.
Marion	73	23	47.8	3.91	T.
Moncure	70	21	47.2	4.79	T.
Monroe	71	19	47.0	3.64	T.
Morganton	71	19	46.2	3.51	0.2
Mountairy	73	18	47.2	1.94	
Mount Holly	.....	.....	.....	3.44	T.
Murphy	.....	.....	.....	3.05	T.
Nashville	70	23	47.2	4.65	T.
Newbern	74	27	51.5	1.99	
Patterson[d, g]	66	18	42.8	3.11	0.5
Pinehurst	74	29	50.4	5.72	
Pittsboro	71	21	46.8	4.13	0.2
Reidsville	73	25	48.0	1.65	T.
Rockingham	71	22	48.3	4.60	T.
Salem	71	20	46.7	2.66	
Salisbury	74[d]	21[d]	45.9[d]	4.70	T.
Saxon	70	18	45.4	1.98	
Scotland Neck	70	27	48.5	4.06	T.
Selma	70	29	50.2	5.35	T.
Settle	78	20	50.2	4.08	0.3
Sloan	76	24	50.0	1.59	T.
Soapstone Mount	71	22[j]	46.0[f]	3.80	T.
Southern Pines	73	27	51.2	4.94	1.0
Southport	76	30	55.6	2.51	
Statesville	78	18	46.8	3.71	T.
Tarboro	75	24	49.4	4.55	T.
Washington	74	25	49.8	3.20	T.
Waynesville	73	12	45.2	2.15	6.0
Weldon *a*	73	24	46.5	3.64	T.
Weldon *b*	.....	.....	.....	3.89	T.
Whiteville	79	23	50.0	2.26	
North Dakota.					
Amenia	73	4	36.4	0.03	0.2
Ashley	77	0	34.0	0.27	1.0
Berlin	76	−2	35.9	0.10	1.0
Buxton	67	0	35.1	T.	T.
Cando	74[f]	−5[f]	35.6[f]	0.35	1.5
Churchs Ferry	80	−1	35.8	T.	T.
Cooperstown[h]	71	9	33.2	.....	.....
Devils Lake	75	−1	33.8	0.01	0.1
Dickinson	78	1	37.6	0.04	T.
Donnybrook	78	−3	36.6	0.20	2.0
Dunseith	70	−10	32.6	0.00	
Edgeley	72	0	37.4	0.07	1.0
Ellendale	76	3	37.7	0.15	1.0
Fargo	71	1	34.8	0.01	0.1
Forman	74	2	36.0	T.	T.
Fort Berthold	73	8	37.2	0.21	
Fort Yates	79	0	39.0	0.08	T.
Fullerton	70	0	35.7	0.19	0.8
Glenullin	73	0	38.0	T.	T.
Hamilton	70	−5	32.4	0.47	4.0
Jamestown	77	0	36.6	0.55	5.5
Kulm	73	2	36.7	0.17	1.1
Larimore	73	1	35.8	T.	T.
Lisbon	74	4	36.6	T.	T.
McKinney	76	−9	35.0	0.02	0.2
Manfred	71	−2	35.0	0.30	3.0
Mayville	72	2	41.6	0.01	0.1
Medora	74	2	36.0	T.	T.
Melville	72[e]	3[e]	35.9[e]	T.	T.
Milton	72	2	34.2	0.00	
Minnewaukon	70	1	35.1	0.00	
Minot	75	2	38.7	0.07	0.7
Minto	70	−5	33.4	0.03	0.5
Napoleon	73	−4	34.6	0.06	1.0
New England	70	0	36.2	T.	T.
Oakdale	72	10	41.6	0.07	T.
Park River	73	2	36.0	0.06	0.6
Pembina	68	−7	33.2	0.39	3.9
Portal	70	−4	34.0	0.05	0.5
Power	76	2	36.2	0.02	T.
Rolla	69	−6	33.6	0.07	0.6
Rugby	68[e]	−5[e]	31.9[e]	0.03	0.3
Sentinel Butte	69	5	40.2	T.	T.
Steele	71	−5	34.2	0.10	1.0
University	65	1	36.4	T.	T.
Wahpeton	72	8	37.2	0.05	T.
Walhalla	72	0	33.6	0.11	1.1
Westhope	70	−7	34.6	0.25	2.5
Willow City	73	−10	32.1	0.00	
Wishek	70	−4	34.6	0.02	0.2
Ohio.					
Akron	67	15	39.2	1.11	7.5
Amesville	70	14	40.0	0.17	0.2
Atwater	.....	.....	.....	0.92	4.0
Bangorville	68	16	39.8	0.24	0.3
Bellefontaine	69	15	40.6	0.19	1.5
Benton Ridge	67[e]	21[e]	41.6[e]	0.32	2.5
Bowling Green	70	18	40.4	0.05	0.5
Bucyrus	69	18	39.0	0.50	1.5
Cadiz	67	18	40.4	0.39	1.9
Cambridge	71	17	41.0	0.46	T.
Camp Dennison	68	18	41.2	0.53	T.
Canal Dover	66	14	38.5	0.58	0.5
Canton	66	18	37.8	1.22	4.7
Cardington	68	17	39.8	0.16	0.7
Chillicothe	70	14	42.6	0.30	0.5
Circleville	67	20	41.2	0.40	T.
Clarington	72	21	42.0	0.17	T.
Clarksville	69	17	43.8	0.40	0.1
Cleveland *a*	63	22	41.1	0.41	1.0
Cleveland *b*	64	22	40.0	0.13	0.4
Clifton	72	15	42.3	0.17	T.
Coalton	72	11	40.8	0.22	T.
Dayton *a*	.....	.....	.....	0.10	T.
Dayton *b*	70	20	41.8	0.63	0.5
Defiance	71	20	40.6	0.21	1.3
Delaware	70	18	39.6	0.20	0.8
Demos	68	19	41.1	0.15	T.
Elyria	68	12	39.6	0.40	1.1
Findlay	73	21	41.9	0.08	T.
Frankfort	66	18	41.6	0.15	T.
Fremont	70	18	41.6	0.18	T.
Garrettsville	68	10	37.4	0.89	3.5
Granville	68	19	40.6	0.18	T.
Gratiot	66	18	40.3	0.31	0.5
Green	66	13	42.8	0.30	T.
Greenfield	63	20	42.3	0.20	T.
Greenhill	68	10	36.9	0.49	2.1
Greenville	70	17	41.0	0.12	T.
Hanging Rock	69	16	43.2	0.21	
Hedges	69	18	39.3	T.	T.
Hillhouse	68	15	38.0	1.03	2.5
Hiram	67	15	39.0	0.94	4.0
Hudson	68	6	38.2	1.08	2.5
Jacksonburg	71	18	42.8	0.65	T.
Killbuck	67	13	39.4	0.46	1.5
Lancaster	68	18	41.0	0.30	T.
Lima	67	19	42.1	0.10	1.0
McConnelsville	71	17	40.8	0.41	0.8
Manara	64	17	40.3	0.29	T.
Marietta	65	24	42.0	0.14	T.
Marion	71	17	41.0	0.23	0.6
Medina	71	0	38.8	1.15	7.0
Milfordton	71	15	39.6	0.17	0.5
Milligan	69	15	39.8	0.30	T.
Millport	69	9	37.8	0.64	1.2
Montpelier	67	22	39.4	0.20	T.
Napoleon	75	21	42.8	0.13	1.0
Nellie	68	13	40.2	0.53	1.6
New Alexandria	68	20	39.8	0.45	1.0
New Berlin	69	13	39.2	0.73	2.5
New Bremen	70	18	41.1	0.23	T.
New Richmond	68	20	43.8	0.56	T.
New Waterford	64	11	36.9	0.68	1.8
North Lewisburg	67	17	41.0	0.22	0.2
North Royalton	66	10	39.4	1.03	5.0
Norwalk	71	14	39.6	0.17	T.
Oberlin	69	15	39.7	0.46	1.0
Ohio State University	67	19	39.8	0.13	0.1

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Orangeville	70	12	37.0	1.10	6.0
Ottawa	67	20	39.8	0.14	T.
Pataskala	67	20	40.2	0.25	0.5
Philo	70	20	42.4	0.06	T.
Plattsburg	68	17	41.1	0.36	1.5
Pomeroy	68	19	41.4	0.30	T.
Portsmouth *a*				0.35	T.
Portsmouth *b*	65	23	43.0	0.35	T.
Pulse	68	18	41.0	0.26	0.2
Rockyridge	70	16	40.8	0.15	T.
Shenandoah	68	14	38.8	0.43	0.5
Sidney	72	17	41.3	0.18	0.4
Somerset	66	11	42.0	0.50	T.
South Lorain	68	18	39.8	0.24	T.
Springfield				0.20	0.1
Thurman	70			0.20	
Tiffin	65	20	40.1	0.25	0.5
Upper Sandusky	68	19	41.4	0.12	0.7
Urbana	68	16	39.6	0.16	0.8
Vickery	69	14	40.2	0.20	T.
Warren	75	8	38.9	1.06	3.6
Wauseon	69	21	39.2	0.16	1.3
Waverly	73	16	41.6	0.21	0.2
Waynesville	70	17	42.2	0.35	T.
Wellington	67	14	40.2	0.35	T.
Willoughby				0.55	3.0
Wilson	69	11	40.0	0.30	T.
Wooster	68	15	39.6	0.40	1.2
Zanesville				0.34	T.
Oklahoma.					
Alva	82	17	52.6	0.33	3.0
Arapaho	78	11	50.6	T.	T.
Beaver	76	10	47.0	0.12	
Binger	78	10	48.8	0.30	
Blackburn	79	12	48.7	0.22	2.0
Chandler	82	18	51.8	0.24	0.8
Cleo	78[g]	11	48.3[g]	0.00	
Cloud Chief	78	15	50.2	T.	T.
Eldorado	82[e]	12[e]	52.8[e]	0.00	
Enid	78	15	51.2	T.	T.
Erick	79	12	51.5	0.10	1.0
Fort Reno	78	18	51.3	0.12	1.2
Fort Sill	78	12	51.3	0.00	
Frederick	76	31	57.0	0.00	
Gage	75	14	47.6	0.50	0.4
Grand	83	10	57.6	0.05	0.5
Guthrie	76	18	51.4	0.12	T.
Harrington	76	18	50.2	0.22	1.5
Hobart	79	13	51.4	0.15	T.
Jefferson	76	15	48.6	0.01	T.
Jenkins	78[g]	17[g]	50.6[g]	0.24	2.0
Kenton	76	15	45.8	0.10	1.0
Kingfisher	79	17	51.7	0.15	1.5
McComb	78	15	51.8	0.06	
Mangum	80	28	55.8	0.00	
Meeker	81	16	52.6	0.25	T.
Newkirk	75	19	50.6	T.	T.
Norman	79	13	51.8	0.05	0.5
Okeene	78[b]	15[e]	50.4[e]	0.10	1.0
Perry	78	17	51.2	0.26	1.0
Sac and Fox Agency	80	22	55.6	0.01	
Shawnee	79	18	53.5	0.08	
Stillwater	78	15	48.8	0.23	0.7
Taloga	79[d]	14[e]	48.2[d]	0.15	1.5
Temple	77	14	52.1	0.08	
Waukomis	83	15	54.5	0.03	
Weatherford	77	11	49.3	0.07	0.8
Whiteagle	79	14	49.8	0.13	0.5
Woodward	81	8	52.7	0.10	1.0
Oregon.					
Albany				6.43	
Alpha	68	36	50.3	10.67	
Arlington	68	26	44.8	0.56	
Ashland	74	31	49.4	0.95	
Astoria	70	37	52.5	17.43	
Aurora (near)	63	32	47.9	6.46	
Bay City	76	37	52.2	17.52	
Bend	69	21	42.8	0.42	
Beulah	70	19	40.0	0.43	
Blackbutte	62	33	46.4	5.60	
Blalock	68	30	48.0	0.46	
Bullrun				8.06	
Burns	67	19	39.0	0.37	
Butter Creek				0.28	
Cascade Locks	63	35	49.2	8.66	
Coquille				9.94	
Corvallis	62	35	48.2	7.48	
Dayville	72	23	48.1	0.18	
Doraville	67	37	47.6	10.43	
Drain	71	37	51.8	3.82	
Ella				0.26	
Eugene	63	37	49.0	4.32	
Fairview	73	39	52.6	7.62	
Falls City	58	32	47.4	17.04	
Forestgrove	71	32	49.0	11.33	
Gardiner	69	40	51.4	11.40	
Glendale	68	35	49.4	5.02	
Glenora	60	31	46.6	30.49	
Oregon—Cont'd.	°	°	°	*Ins.*	*Ins.*
Gold Beach	68	36	53.2	13.03	
Government Camp	61	24	41.8	9.34	10.0
Grants Pass	68	31	48.9	2.30	
Grass Valley	62	22	40.0	0.77	
Heppner	67	23	44.2	0.17	
Hood River	61	31	46.5	4.58	
Huntington	68	19	41.6	0.47	
Jacksonville	70	32	48.7	2.54	
John Day	70	24	47.0	0.36	
Joseph	68	19	43.4	1.02	
Kerby	65	32	48.7	7.27	
Klamath Falls	69	23	44.6	0.60	
Lagrande	65	21	45.2	0.92	
Lakeview	71	18	40.8	0.20	
Lonerock	67	21	45.7	0.58	
McKenzie Bridge	72	28	46.8	5.59	
McMinnville	70	33	49.4	9.96	
Marshfield	70	37	53.2	7.03	
Meacham				0.63	T.
Monroe	64	34	49.4	6.69	
Mount Angel	68	37	50.4	8.45	
Nehalem				19.11	
Newport	74	41	53.8	9.47	
Ontario				T.	
Pendleton	72	20	45.0	0.33	
Pine	65	15	39.9	0.82	
Prineville	68	17	43.8	0.46	
Riverside	70	13	39.9	0.25	
Salem	62	36	50.2	6.53	
Silverlake	71	8	38.5	0.55	
Sparta	65	23	44.3	0.30	3.0
Stafford	68	33	49.1	9.49	
The Dalles	64	30	46.0	1.01	
Toledo	77	36	52.3	12.33	
Umatilla	68	24	45.5	0.14	
Vale	68	12	37.5	0.43	
Wallowa	65	17	40.6	0.69	
Wamic	63	24	42.8	0.89	
Warm Spring	67	21	45.8	0.27	
Weston	69	19	44.4	1.11	
Williams	79	28	50.4	3.55	
Pennsylvania.					
Aleppo	68	9	39.6	0.26	T.
Altoona	65	12	37.8	0.63	
Beaver Dam				0.53	T.
Bellefonte	65	17	40.0	0.56	0.5
Brookville				0.79	1.8
Browers				2.27	2.0
California	72	20	41.8	0.44	0.2
Cassandra	63	8	36.4	1.20	7.0
Clarion				0.68	2.0
Claysville	70	15	39.8	0.27	0.5
Coatsville	64	18	40.8	3.22	6.4
Confluence				0.43	2.0
Coudersport	64	− 4	35.0	0.60	6.0
Davis Island Dam				0.19	T.
Derry	66	12	39.5	0.48	T.
Doylestown				2.82	
Dushore	66	12	34.3	0.97	5.6
East Bloomsburg				0.92	
East Mauch Chunk	61	13	38.4	2.02	5.0
Easton	58	18	38.2	1.88	2.6
Ellwood Junction				0.64	0.3
Emporium	62	11	37.8	0.64	2.2
Ephrata	63	16	39.8	1.16	6.0
Everett	65	12	37.9	0.43	0.5
Forks of Neshaminy				2.73	
Franklin	67	0	38.0	0.74	2.0
Freeport	67	8	38.9	0.86	1.3
Gettysburg	64	17	41.7	0.71	5.0
Girardville				2.55	13.0
Gordon	59	10	37.0	1.03	8.0
Greensboro				0.20	T.
Greenville	68	10	37.6	1.07	8.0
Hamburg	72	16	40.6	1.73	3.5
Hanover	65	16	40.9	1.75	9.4
Herrs Island Dam				0.22	
Huntingdon *a*				0.54	T.
Huntingdon *b*	67	15	39.2	0.61	T.
Indiana	68	8	39.0	0.90	4.5
Irwin	76	19	41.9	0.19	0.5
Johnstown	78	18	41.5	0.96	1.4
Keating				0.36	T.
Kennett Square	62	18	40.6	3.17	10.0
Lansdale				2.35	
Lawrenceville	65	3	34.6	0.40	1.5
Lebanon	65	16	40.4	1.63	7.1
Leroy	61	7	36.2	0.65	5.4
Lewisburg	61	16	38.6	0.72	T.
Lockhaven *a*	62	14	38.8	0.48	T.
Lockhaven *b*				0.66	T.
Lock No. 4				0.14	0.5
Lycippus	68	18	40.9	0.32	0.9
Marion	64	16	39.2	0.45	T.
Mifflin				0.45	T.
Mifflintown	61	17	39.0	0.69	0.8
Milford	61	9	36.0	1.79	2.5
Montrose	56	17	34.0	1.18	8.5
Pennsylvania—Cont'd.	°	°	°	*Ins.*	*Ins.*
New Germantown	67	18	40.4	0.85	
Oil City				0.92	
Ottsville				1.94	
Parker				0.78	3.3
Philadelphia	63	24	43.6	2.38	1.0
Pocono Lake	58	3	32.7	1.48	12.0
Point Pleasant				2.25	
Pottsville				1.86	
Quakertown	62	16	39.4	1.57	2.0
Reading	62	19	40.6	1.86	5.0
Saegerstown	68	4	37.2	1.25	5.0
St. Marys	60	10	35.4	0.45	2.5
Saltsburg				0.56	1.0
Seisholtzville				1.80	
Selinsgrove	62	15	40.8	0.70	1.2
Shawmont				1.91	
Skidmore	79	5	38.2	0.76	1.0
Smethport	68	2	35.2	0.75	7.5
Smiths Corners				1.57	
Somerset	64	15	38.7	1.80	8.4
South Eaton	58	14	36.8	1.06	3.0
Springmount				1.79	
State College	61	14	38.5	0.42	0.4
Swarthmore	63	19	41.6	2.39	2.5
Towanda	61	10	35.6	0.69	3.2
Troutrun				0.40	
Uniontown	70	21	40.8	0.25	0.5
Warren	64	2	36.8	1.21	10.4
Wellsboro	60	15	38.1		4.0
Westchester	62	18	40.5	3.31	5.8
West Newton				0.19	1.0
Wilkesbarre	59	16	37.8	1.18	3.0
Williamsport	57	15	39.7	0.51	0.5
Rhode Island.					
Bristol	58	18	38.3	2.08	1.5
Kingston	57	7	35.4	3.15	1.8
Providence *a*	57	15	38.2	1.95	3.0
Providence *c*	60	12	37.2	1.95	2.2
South Carolina.					
Aiken	78	26	52.4	2.45	
Allendale	74[f]	26[f]	51.7[f]	1.55	
Anderson	76	28	51.7	2.12	T.
Barksdale	77	28	51.2	2.02	T.
Batesburg	75	30	54.2	3.52	2.0
Beaufort	75	33	56.5	4.18	
Bennettsville	76	26	50.4	3.45	
Blackville	76	28	53.0	2.78	
Bowman	76	25	52.6	2.93	
Calhoun Falls				2.49	
Camden				3.12	T.
Cheraw *a*	73	27	49.6	3.44	T.
Cheraw *b*				3.70	T.
Clarks Hill	72	29	52.6	2.18	T.
Clemson College	76	23	49.6	2.41	
Conway	76	26	51.6	1.20	T.
Darlington	79	25	51.1	2.81	
Dillon	74	25	50.6	2.82	
Duewest	77	31	52.7	1.68	T.
Edisto				2.14	T.
Effingham				3.40	T.
Florence	75	25	50.0	3.09	
Gaffney	74	24	49.9	3.76	T.
Georgetown	72	32	53.9	2.98	
Greenville	70	22	46.2	3.70	
Greenwood	68	29	50.5	2.32	
Heath Springs	72	28	48.0	3.42	T.
Kingstree *a*	74	29	52.4	1.80	T.
Kingstree *b*				2.17	T.
Liberty	70	25	48.8	3.33	T.
Little Mountain	78	31	52.4	2.94	T.
Lugoff	74	24	51.3	3.57	
Newberry	72	25	50.6	2.56	T.
Pinopolis *h*	76	32	53.2	2.98	
St. George	74	28	52.3	1.92	T.
St. Matthews	72	30	52.5	3.01	T.
St. Stephens				2.34	
Saluda	75	24	51.0	2.65	T.
Santuck	71	22	48.8	3.19	T.
Scivern	74	24	50.1	2.42	
Smiths Mills				2.10	
Society Hill	70	28	50.1	3.07	T.
Spartanburg	73	25	49.8	3.99	T.
Statesburg	74	30	53.4	3.38	
Summerville	74	28	53.2	3.08	
Trenton	71	32	52.9	2.39	T.
Trial	75	25	52.6	2.42	
Walhalla	80	25	50.8	3.32	
Walterboro	79	26	55.6	2.54	
Winnsboro	71	30	51.6	3.01	
Winthrop College	77	27	50.2	3.63	T.
Yemassee	74	31	53.3	3.02	
Yorkville	72	28	51.8	4.39	T.
South Dakota.					
Aberdeen	79	2	38.3	0.33	2.5
Academy	76	9	42.4	0.08	0.4
Alexandria	74	5	39.0	T.	T.
Armour	76	6	41.6	0.11	0.1
Ashcroft	79	5	37.4	0.00	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
South Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bowdle	71	1	38.3	T.	
Brookings	71	2	36.4	0.02	T.
Canton	71	6	39.6	0.02	0.5
Cavite	77	−15	39.0	T.	
Centerville				0.06	0.6
Chamberlain	77	8	41.2	0.11	T.
Cheyenne	74	2	36.2	0.20	T.
Clark	70	3	38.6	T.	T.
Clear Lake	67	5	37.9	0.26	1.0
DeSmet	70[s]	10[s]	39.2[s]	0.05	
Doland	71	−2	36.4	0.10	T.
Elkpoint	80[d]	8[c]	41.6[d]	0.02	0.5
Fairfax	74	9	45.8	T.	T.
Farmingdale				T.	T.
Faulkton	72	2	38.4	0.05	
Flandreau	77	3	33.0	T.	T.
Forestburg	73	3	37.6	0.12	1.2
Fort Meade	70	17	43.2	0.16	
Gannvalley	73	−3	38.2	0.00	
Grand River School	76	4	38.0	0.38	T.
Greenwood	80	12	43.4	0.15	0.5
Herreid	71	8	37.0	0.10	
Highmore	72	4	38.8	T.	T.
Hotch City	74	2	38.0	0.35	1.0
Howard	73	3	33.4	0.28	2.0
Howell	72	0	35.8	0.12	T.
Ipswich	71	1	36.2	T.	T.
Kidder	72	8	36.1	0.10	T.
Kimball	73	4	38.0	0.15	T.
Leola				0.05	1.0
Leslie	78[d]	0[d]	40.4[d]	T.	T.
Marion	73	9	40.2	0.00	
Mellette	75[c]	0[c]	38.0[c]	T.	T.
Menno	78	8	41.0	0.22	1.0
Millbank	78	8	39.2	T	T.
Mitchell	77	11	40.8	T.	T.
Oelrichs	68	8	41.2	T.	T.
On-the-Trees Camp	73	3	38.6	0.06	T.
Pine Ridge	73	10	39.8	T.	T.
Plankinton	75	7	40.0	T.	T.
Ramsey	80	−1	37.0	T.	T.
Redfield	73	−1	35.6	0.17	T.
Silver City				0.13	1.0
Sioux Falls	74	10	40.2	0.03	0.3
Sisseton Agency	71	6	39.5	0.07	0.7
Spearfish	71	20	46.7	0.15	1.0
Stephan	72	4	37.8	0.12	T.
Tyndall	80	8	42.0	0.21	0.1
Vermillion	76	11	41.9	0.12	T.
Watertown	69	2	35.3	0.01	
Wentworth	77	5	40.0	T.	
Wolsey				0.20	T.
Tennessee.					
Andersonville	68	20	44.2	2.65	
Ashwood	73	24	48.0	2.33	
Benton	73	21	46.5	3.49	
Bluff City				3.80	6.0
Bolivar	72[k]	23[k]	44.7[k]	1.24	
Bristol	67	17	41.8	3.91	4.0
Brownsville	71	28	47.6	1.40	
Byrdstown	69	24	45.4	2.71	T.
Carthage	75	22	47.8	2.03	
Cedar Hill	75	25	48.2	1.12	
Celina				1.93	
Charleston				3.04	
Clarksville	72	26	47.3	1.49	
Clinton				2.90	
Covington	71	24	48.0	1.15	T.
Decatur	74	22	46.8	4.09	
Dickson	73[g]	21[g]	45.0[g]	2.70	
Dover	78	21	47.0	1.28	
Dyersburg	73	25	48.8	0.59	
Elizabethton	69	15	46.6	2.13	7.0
Erasmus	73	16	42.6	4.66	0.5
Florence	71	24	47.7	2.69	
Franklin	70	24	46.2	2.62	
Grace				3.50	
Greeneville	66	19	45.0	4.46	11.7
Halls Hill				2.99	
Harriman	68	23	46.0	3.50	
Hohenwald	73	15	44.7	2.54	
Iron City	72	19	47.2	3.49	
Isabella	68	22	45.6	3.24	
Jackson	75	21	48.2	0.95	
Johnsonville	74	20	46.4	1.46	
Jonesboro	68	11	43.2	3.28	8.5
Kenton	75	20	47.4	0.70	
Kingston				3.01	
Lafayette	75	20	46.0	2.02	
Leadvale				3.30	0.3
Lewisburg	75	22	48.0	2.97	
Loudon				2.90	
Lynnville	72	23	47.4	2.50	
McKenzie	73	24	49.0	0.90	
McMinnville	73	21	46.2	3.13	
Maryville	69	23	47.0	3.73	2.0
Newport	66	22	45.3	4.15	3.0
Nunnelly	76	19	46.4	2.32	
Tennessee—Cont'd.					
Palmetto	72	23	48.0	2.84	
Pope	76	20	47.3	1.80	
Rogersville	71	21	44.2	3.64	2.0
Rugby	72	14	42.8	4.60	T.
Savannah	75	20	48.3	2.08	
Sewanee	68	23	46.6	4.79	
Silver Lake	59	12	39.4	3.53	6.0
Springdale	67	18	43.1	3.97	3.0
Springville	75	20	46.8	1.33	
Tazewell				3.43	2.0
Tellico Plains	74	20	48.0	3.75	T.
Tracy City	69	20	43.6	4.42	
Trenton	74	21	47.6	1.21	
Tullahoma	71	21	46.1	3.24	
Walling				5.55	
Wildersville	70	23	48.0	1.15	
Yukon	72	25	50.1	3.82	
Texas.					
Albany	83	20	55.5	0.13	
Alvin				3.68	
Arthur				0.74	
Athens	90	27	57.2	0.00	
Austin	78	31	60.3	0.40	
Ballinger	77	24	54.0	0.79	
Beaumont	88	33	63.8	3.70	
Beeville	82	29	61.6	1.13	
Bigspring	81	23	52.6	0.88	
Blanco	76	21	55.4	0.23	
Boerne	79	24	58.0	0.55	
Bonham	80	26	54.7	0.45	
Booth				2.72	
Bowie	84	20	54.3	0.13	
Brenham	81	31	59.7	1.29	
Brighton	78[l]	32[d]	63.2[g]	2.97	
Burnet	80	25	58.6	T.	
Channing	76	17	49.0	0.25	T.
Childress	78	17	52.4	T.	
Claude	78	12	46.2		
Claytonville	79	22	53.1	0.37	
Coleman	89	28	60.4	0.30	
College	88	31	61.8	1.10	
Colorado	79	19	53.0	0.45	
Columbia	79	30	60.0	3.70	
Columbus				1.46	
Comanche	79[g]	22[g]	55.6[g]	0.12	
Corsicana	85	30	59.0	0.26	
Crockett	82	27	59.6	2.05	
Cuero	81	32	60.2	3.51	
Dallas	84	26	55.6	0.18	
Danevang	82	28	60.7	3.15	
Decatur				0.45	
Dialville	76	32	59.0	1.89	
Duval	80	30	59.8	0.15	
Estelle	82	26	56.2	T.	T.
Fort Brown	81[m]	41	67.3[g]	1.24	
Fort Clark	77	28	59.3	0.50	
Fort Davis	74	16	47.0	0.34	T.
Fort McIntosh	85[g]	30	63.3[d]	2.35	
Fort Ringgold	85	33	64.9	0.72	
Fort Stockton	83[c]	25[c]	52.8[c]	1.75	
Fredericksburg	76[c]	24[c]	55.8[c]	0.37	
Gainesville	81	22	54.3	0.10	
Gatesville	79	26	57.0	1.10	
Georgetown	82	26	58.8	0.32	
Graham	86	19[a]	55.0[a]	T.	T.
Grapevine	83[d]	26[d]	57.8[d]	0.04	
Greenville	90	24	57.6	0.20	
Hale Center	77	24	52.6	0.15	
Hallettsville	79	31	60.9	2.15	
Haskell	87	19	54.2	T.	T.
Hearne	83	28	58.6	1.23	
Hempstead				2.71	
Hewitt				0.22	
Hillsboro	79	26	56.7	0.08	
Hondo	78	28	60.4	1.00	
Houston	79	32	59.6	3.26	
Huntsville	79[c]	29[c]	57.5[c]	1.34	
Jefferson	77	24	54.2	2.43	
Jewett	80	25	55.2	0.30	
Junction				0.48	
Kaufman	79	28	57.4	0.20	
Kent	74	15	49.8	0.37	0.1
Kerrville	79	29	55.6	0.57	
Knickerbocker	80	23	54.4	1.63	
Kopperl				0.10	
Lampasas	80	23	55.4	0.15	
Lapara				0.60	
Liberty				1.65	
Llano	78	29	53.0	T.	
Longview	77	30	52.3	2.30	
Luling	79	30	60.5	0.57	
McKinney	83	23	54.4	0.07	
Marlin	88	29	57.6	0.56	
Menardville	77	17	51.8	0.98	
Mexia	79	30	58.9	0.00	
Midland	70	22	49.8	1.90	
Mount Blanco	75	20	49.8	0.06	
Nacogdoches	82	23	58.6	0.88	
Texas—Cont'd.					
New Braunfels	78	31	59.2	0.73	
Orange				1.76	
Panter				0.61	
Paris	81	29	55.8	0.85	
Pearsall	79	28	62.2	0.40	
Pecos	87	25	52.4	0.90	
Pierce	82	28	60.8	2.53	
Port Lavaca	82[c]	29[c]	61.8[c]	4.91	
Quanah	77	25	52.6	T.	T.
Rhineland	80	15	51.8	0.00	
Riverside				0.63	
Rockisland	84	29	60.6	1.24	
Rockland	83			1.74	
Rockport	78	38	65.2	1.75	
Runge	80	27	62.5	0.60	
Sabinal	86	24	59.0	0.95	
San Saba	77	22	55.4	0.22	
Sherman	76	29	55.6	0.58	
Sonora	76	19	53.4	2.52	
Sugarland	81	28	60.4	1.80	
Temple *a*	77	26	56.7	0.34	
Temple *b*	82	25	57.8	0.35	
Texline	73	11	45.4	T.	T.
Tilden	87	26	64.8	1.06	
Trinity	84	24	59.1	0.79	
Tulia	75	14	48.6	0.15	T.
Tyler	77	31	56.2	0.93	
Victoria	81	32	62.1	4.72	
Waco	80	31	57.6	0.06	
Waxahachie	85	26	55.6	0.48	
Weatherford	77	25	54.8	0.09	T.
Wichita Falls				0.00	
Utah.					
Alpine				0.00	
Aneth	67	11	40.0	0.00	
Beaver	74	12	42.6	0.00	
Blackrock	65	5	37.4	0.00	
Callao	70	8	35.7	0.00	
Castledale	68	1	33.6	0.00	
Castle Rock				0.00	
Cisco	66	5	35.9	0.00	
Corinne	69	16	39.8	0.00	
Coyoto	69	2	35.4	0.00	
Deseret	70	3	37.8	0.00	
Emery	56	9	33.6	0.00	
Ex. Farm	77	15	46.0	0.00	
Farmington	62	20	40.5	0.00	
Fillmore	83	19	48.9	0.00	
Fort Duchesne	60	5	32.6	0.00	
Frisco	66	25	46.1	0.00	
Garrison	67	18	41.0	0.00	
Giles	67	8	36.0	0.00	
Government Creek	66	18	42.1	T.	
Heber	66	10	37.4	0.00	
Henefer	67	5	37.1	0.00	
Hite	73	22	45.8	0.00	
Huntsville				T.	
Ibapah	70	5	36.8	0.00	
Kanab	68[c]	11[c]	40.0	0.00	
Kelton	59	10	33.6	0.00	
La Sal	60	13	39.0	0.00	
Levan	60	15	39.4	0.00	
Loa	62	2	33.9	0.00	
Logan	62	21	40.9	0.00	
Manti	68	14	40.5	0.00	
Marysvale	72	6	39.5	T.	
Meadowville	58	11	35.2	0.05	0.5
Minersville	66	19	43.8	0.00	
Moab	65	13	38.8	0.00	
Morgan	63	8	35.8	0.00	
Mount Nebo	64	16	42.3	0.00	
Mount Pleasant	65	18	41.8	0.00	
Nephi				0.00	
Ogden	62	24	42.2	0.00	
Panquitch				0 00	
Parowan	64	15	40.9	T.	
Payson				0.00	
Pinto	65[c]	10[c]	38.6[c]	0.00	
Plateau	68	4	37.8	T.	T.
Promontory	62	5	44.4	0.00	
Provo	71	17	42.4	0.00	
Ranch	67	9	39.4	0.00	
Randolph				0.03	
Richfield	72[j]	9[j]	40.3[j]	0.00	
St. George	77	22	49.4	0.00	
Salt Air	59	21	39.7	0.00	
Scipio	70	3	39.0	0.00	
Snowville	70	8	37.0	T.	T.
Soldier Summit	59	3	32.5	0.00	
Thistle	70	8	37.0	0.00	
Tooele	62	23	42.4	0.00	
Tropic	68	9	41.6	0.00	
Utah Lake				0.00	
Woodruff	66	0	34.4	T.	T.
Vermont.					
Burlington	52	12	34.4	0.52	3.0
Cavendish	57	−2	29.7	1.16	19.2
Chelsea	50	−4	26.2	0.90	13.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Vermont—Cont'd.	°	°	°	*Ins.*	*Ins.*
Chittenden				1.37	13.7
Cornwall	49	2°	30.8°	0.78	3.0
Derby	50	2	23.4	0.50	.....
Enosburg Falls	50	— 9	28.3	0.75	.....
Jacksonville	52	— 5	29.4	2.35	14.0
Manchester	51	— 1	30.7	0.69	10.5
Morrisville	55	— 6	27.8	0.91	7.7
Norwich	55	— 4	27.2	0.75	7.0
St. Johnsbury	52	— 2	27.2	1.09	4.6
Wells	50	0	28.4	1.15	15.0
Westfield	55	0	26.7	1.84	13.5
Woodstock	52	—10	26.5	1.44	12.0
Virginia.					
Ashland	64	22	43.4	2.05	3.0
Barboursville	70	24	45.0	1.45	T.
Bedford	77	19	46.7	.....	.....
Bigstone Gap	67	20	43.4	3.35	1.0
Blacksburg	67	17	40.6	2.24	T.
Buchanan				1.35	
Buckingham	70	17	42.6	1.58	
Burkes Garden	67	— 3	37.3	3.01	3.0
Callaville	68°	22°	46.2°	3.35	
Charlottesville	78	29	48.2	0.94	
Clarksville				3.10	0.2
Columbia	70	18	44.0	1.91	2.0
Dale Enterprise	68	19	42.2	0.80	1.0
Danville				1.50	T.
Dinwiddie	71	21	44.4	3.84	1.0
Elk Knob	65	22	44.3	2.94	4.0
Farmville	65	23	43.4	3.83	T.
Fredericksburg	70	22	43.2	2.27	3.5
Hampton	68	30	47.8	2.68	T.
Hot Springs	61	14	37.9	1.10	1.0
Ivanhoe				1.52	
Lexington	70	16	41.6	1.05	T.
Lincoln	71	17	41.0	1.94	.....
McDowell	.....	12	.....	0.07	0.5
Mendota				3.41	3.8
Newport News	67	29	48.3	2.62	T.
Petersburg	68	26	44.6	3.56	1.5
Radford				0.70	1.0
Riverton	.....	.....	.....	0.75	
Roanoke	74	.....	.....	1.50	2.0
Rockymount	.....	18	.....	1.72	
Saxe	70	20	45.2	2.60	T.
Shenandoah	.....	.....	.....	0.83	T.
Speers Ferry				4.05	2.0
Spottsville	68	22	44.9	2.72	0.5
Staunton	70	19	43.5	1.34	1.0
Stephens City	76	22	42.2	1.05	T.
Warsaw	68	25	43.7	2.25	2.0
Wilkerson	69	26	44.4	2.06	1.0
Williamsburg	66	23	45.1	.....	
Woodstock	71	22	42.4	0.84	T.
Wytheville	69	20	43.0	1.91	1.0
Washington.					
Aberdeen	73	32	49.3	15.84	
Anacortes	.....	.....	.....	3.98	
Ashford				12.05	
Bellingham	65	31	49.4	5.75	
Blaine	60	32	48.1	5.71	
Brinnon	64	36	47.5	23.56	
Cedonia	57	26	42.0	2.02	2.3
Centralia	69	31	49.2	10.04	
Cheney	70	21	42.4	0.91	
Clearbrook	63	33	47.4	6.28	
Clearwater	60	35	48.0	21.98	
Cle Elum	62	22	40.8	3.62	0.8
Colville	57	22	39.8	1.65	T.
Conconully	57	26	39.6	1.64	2.0
Coupeville	66	32	50.0	3.36	
Crescent	63	19	41.0	1.13	.....
Cusick	60	20	39.6	2.33	
Danville	57	21	39.8	1.48	4.0
Dayton	75	22	47.2	0.88	
East Sound	67°	28°	48.0°	6.58	
Ellensburg	62	21	41.7	1.25	
Ephrata	65	24	45.2	0.70	
Granite Falls	.....	.....	.....	9.51	
Horseheaven				0.40	
Ilwaco	76	37	54.4	16.82	
Lacenter	70	33	47.9	8.36	
Lakeside	60	29	41.2	1.04	T.
Lester [a]	68	32	45.8	.....	6.0
Lind	68	29	46.3	0.36	
Loomis	57	29	43.4	1.70	2.0
Mottinger Ranch	68	28	47.2	0.28	
Mount Pleasant	61	40	50.2	6.17	
Moxee	66	20	43.4	0.62	
Northport	55	22	40.5	1.77	3.0
Odessa	67	25	46.3	.....	
Olga	60	33	47.9	5.17	
Olympia	64	32	47.2	13.23	
Pinehill	62	29	45.4	2.10	T.
Pomeroy	70	24	46.6	T.	
Port Townsend	61	38	49.0	3.92	
Rattlesnake	59	30	42.8	0.39	T.
Republic	56	29	38.6	1.57	5.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Washington—Cont'd.	°	°	°	*Ins.*	*Ins.*
Ritzville	.....	.....	.....	0.28	
Ritzville (near)	.....	.....	.....	0.62	
Rosalia	65	25	44.9	0.94	
Sedro	63	32	48.4	6.35	
Snohomish	62	34	48.6	9.36	
Snoqualmie	68	34	48.8	11.79	
Southbend	78	35	54.8	17.99	
South Ellensburg	60	20	41.0	0.62	
Sprague	.....	.....	.....	1.50	
Sunnyside	64	24	44.6	0.37	
Trinidad	65	28	44.8	0.60	
Twisp	59	23	38.9	2.17	4.0
Union	62	32	47.7	19.34	
Vancouver	71	34	50.0	7.21	
Vashon	60	38	48.2	11.49	
Waterville	55	23	39.5	1.01	2.0
Wenatchee (near)	55	26	41.0	1.61	2.0
Wilbur	62	20	41.4	1.40	0.5
Zindel	67°	30°	48.0°	1.63	
West Virginia.					
Bancroft	75	22	45.0	T.	
Bayard	62	13	35.7	0.88	.....
Bens Run	69	21	42.6	0.15	1.0
Beverly	64	14	36.5	1.35	6.0
Bluefield	76	15	44.6	0.46	4.0
Buckhannon	73	13	40.6	0.33	1.5
Burlington	67	18	38.8	0.68	T.
Cairo	75°	12°	41.2°	0.49	T.
Central	68	15	39.8	0.36	T.
Charleston	68	25	47.2	0.45	T.
Creston	67	14	40.8	0.07	T.
Cuba	68	15	42.4	0.22	T.
Doane	69	16	44.4	0.26	1.5
Elkhorn	66	16	42.8	3.05	6.0
Fairmont	.....	.....	.....	0.44	T.
Glenville	68	15	41.4	0.47	2.0
Grafton	69	16	41.2	0.30	2.0
Green Sulphur Springs	69	9	41.8	1.24	4.0
Hamlin	73	16	41.5	0.39	
Harpers Ferry	.....	.....	.....	1.31	.....
Hinton	.....	.....	.....	1.64	2.0
Huntington	68	19	41.4	0.10	
Leonard	75	20	39.6	0.87	6.0
Lewisburg	65	9	37.6	1.38	6.0
Logan	72	24	45.8	1.70	
Lost Creek	66	10	37.0	0.26	T.
Mannington	67	15	40.7	0.33	0.7
Martinsburg	67	18	40.2	1.05	
Moorefield	75	16	40.2	0.95	T.
Morgantown	67	21	41.7	0.15	T.
Moundsville	67	21	41.8	0.24	1.7
New Cumberland	68	18	40.9	0.55	T.
New Martinsville	67	21	41.8	0.12	T.
Nuttallburg	80	20	47.4	0.26	0.6
Parsons	65	14	38.7	0.66	0.6
Philippi	68	12	39.0	0.46	2.2
Pickens	64	14	37.4	2.20	5.0
Point Pleasant	70	21	44.2	0.20	T.
Princeton	66	16	40.3	3.20	0.5
Romney	68	20	40.6	0.55	T.
Rowlesburg	.....	.....	.....	0.76	3.3
Ryan	70	13	40.2	0.18	.....
Smithfield	67	15	38.7	0.44	0.2
Southside	68	15	42.6	0.16	.....
Terra Alta	64	10	36.2	0.30	3.0
Uppertract	69	21	40.5	0.77	1.0
Valley Fork	68	17	41.6	0.50	4.0
Wellsburg	64	19	39.9	0.50	0.5
Weston	69	29	41 0	0.10	T.
Wheeling [a]	.....	.....	.....	0.25	T.
Wheeling [b]	73	26	44.4	0.27	0.5
Williamson	70	25	44.9	2.06	.....
Wisconsin.					
Amherst	69	5	37.0	0.45	T.
Antigo	65	3	35.5	0.25	0.5
Appleton	69	8	39.0	0.06	0.2
Appleton Marsh	69	5	37.0	0.27	T.
Ashland	.....	.....	.....	0.48	3.0
Barron	72	3	40.1	T.	T.
Beloit	67	14	39.2	0.10	
Berlin	69	9	37.4	0.44	T.
Brodhead	70	11	40.2	0.14	
Burnett	68	10	38.4	0.17	T.
Butternut	69	— 1	34.2	0.10	1.0
Chilton	68	10	38.2	0.20	0.2
Citypoint	72	.....	.....	T.	T.
Darlington	68	8	34.5	0.03	
Downing	72	5	35.9	0.10	0.5
Easton	77	6	37.2	0.13	
Eau Claire	72	15	37.9	0.24	T.
Fond du Lac	67	9	37.5	0.39	T.
Grand Rapids	68	4	37.4	0.33	T.
Grand River Locks	.....	.....	.....	0.40	
Grantsburg	70	2	36.0	T.	T.
Hancock	66	6	37.6	0.49	T.
Harvey	67	11	38.8	0.09	T.
Hayward	69	— 3	33.8	0.02	0.2
Hillsboro	70	6	37.0	0.25	T.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Wisconsin—Cont'd.	°	°	°	*Ins.*	*Ins.*
Koepenick	72	0	35.3	0.40	3.0
Lancaster	69	9	38.1	0.26	T.
Madison	64	13	39.7	0.03	
Manitowoc	68	11	39.2	0.09	
Meadow Valley	71	3	36.4	0.27	T.
Medford	69	1	36.2	0.40	
Menasha	.....	.....	.....	0.03	T.
Minocqua	66	11	35.4	0.21	2.0
Mount Horeb	66	5	37.6	0.03	T.
Neillsville	68	4	36.2	0.21	
New London	70	6	36.8	0.40	T.
Oconto	68	9	36.9	0.26	T.
Osceola	68	7	36.0	T.	T.
Oshkosh	69	8	39.0	0.13	T.
Pine River	73°	6°	38.0°	0.10	T.
Portage	71	10	40.2	0.05	
Port Washington	68	8	37.2	0.08	
Prairie du Chien [a]	84	11	43.9	0.35	1.0
Prentice	69	— 3	36.0	0.03	0.1
Racine	72	15	42.1	0.17	
Sheboygan	69	15	41.0	0.14	T.
Stanley	60	3	36.0	0.38	0.6
Stevens Point	78	3	38.2	0.31	1.0
Tomahawk	65	2	33.0	0.02	
Valley Junction	72	7	37.4	.....	
Viroqua	67	8	38.3	0.28	0.2
Watertown	65	10	37.6	0.14	T.
Waukesha	65	12	39.3	0.22	T.
Waupaca	68	6	36.2	0.33	T.
Wausau	65	— 3	35.4	0.03	
Whitehall	68	8	36.9	T.	T.
Wyoming.					
Afton	65	10	36.4	0.08	0.5
Alcova	60	12	40.4	0.00	
Basin	63	5	36.1	0.00	
Bedford	62	10	35.4	0.09	0.9
Border	60	3	32.6	0.05	0.5
Buffalo	70	4	38.4	0.05	T.
Cambria	78	12	42.6	0.13	0.5
Daniel	60	0	29.2	0.00	
Embar	62	10	39.0	T.	T.
Evanston	61	9	36.0	0.00	
Fort Laramie	74	12	39.9	0.05	
Fort Washakie	64	7	37.0	0.02	0.2
Gillette [f]	68	14	41.8	0.10	1.0
Granite Canyon	.....	.....	.....	T.	T.
Griggs	72	6	39.5	T.	T.
Hyattville	68	9	40.2	0.00	
Iron Mountain	61	5	38.0	0.02	0.2
Kirtley	68	9	40.4	T.	
Laramie	61	5	35.4	0.04	0.5
Leo	57	3	36.0	T.	T.
Little Medicine	57	0	32.2	T.	T.
Lolabama Ranch	61	3	34.2	0.04	
Lusk	68	3	38.3	0.00	
Meeteetse	65	14	37.0	0.15	1.5
Moore	67	10	42.6	0.02	0.2
Moorcroft	71	15	40.8	0.10	1.0
Phillips	73	8	41.4	T.	T.
Pine Bluff	73	2	40.3	T.	T.
Red Bank	65	9	41.4	0.95	.....
Sheridan	70	4	41.0	0.10	
South Pass City	60	— 8	32.0	0.20	2.0
Wells	55	0	28.5	0.06	0.6
Yellowstone Park (C. H.)	53	5	28.7	0.37	8.0
Yellowstone Pk. (Foun'n)	55	.....	.....	0.11	.....
Yellowstone Pk. (Lake)	52	11	31.0	0.06	.....
Yellowstone Pk. (Norris)	.....	.....	.....	0.45	4.5
Yellowstone Pk. (U. Ba'n)	56	5	30.7	0.55	6.0
Yellewstone Pk. (Soda B.)	58	3	30.1	0.40	3.0
Porto Rico.					
Adjuntas	90	55	72.0	7.82	
Aguirre	98	68	81.2	3.66	
Caguas	91	60	76.4	8.12	
Canovanas	89	68	78.4	7.91	
Coamo	91	64	78.0	4.38	
Corozal	96	65	81.4	3.35	
Fajardo	91	65	78.8	10.93	
Guanica	88	60	74.9	4.73	
Hacienda Colosa	92	64	77.8	12.20	
Hacienda Josefa	.....	.....	.....	6.72	
Humacao	89	73	81.6	7.02	
Isabela	88	68	77.8	10.50	
Juana Diaz	95	65	78.5	5.38	
La Carmelita	87	60	73.9	16.17	
La Ysolina	90	62	77.1	10.58	
Lares	90	60	74.8	15.25	
Manati	94	63	78.2	8.44	
Maunabo	92	66	78.2	6.55	
Mayaguez	95	64	78.7	9.21	
Morovis	91	58	75.3	4.40	
Ponce	92	69	80.8	3.00	
Rio Blanco	89	65	77.4	9.96	
Rio Piedras	.....	.....	.....	4.73	
San German	90	64	77.6	8.59	
San Lorenzo	97	61	76.2	5.29	
San Salvador	87	62	73.5	14.93	
Santa Isabel	90	66	78.1	4.53	

TABLE II.—*Climatological record of voluntary and other cooperating observers. Late reports for September*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Porto Rico—Cont'd.	°	°	°	*Ins.*	*Ins.*
Vieques	90	60	78.7	4.14	
Yauco	86	66	77.2	7.89	
New Brunswick.					
St. John	48	13	32.6	2.72	0.9
Late reports for October, 1904.					
Alaska.	°	°	°	*Ins.*	*Ins.*
Chestochena	47	4	28.2	.....	
Fairbanks	52	−7	28.0	0.10	1.1
Kenai	56	9	35.9	1.71	6.4
Petersburg	69	31	46.1	12.89	
Sunrise	53	13	35.6	9.35	13.5
Wood Island	57	24	42.2	4.84	
California.					
Calexeco	.....	.....	.....	0.00	
Crockers	.....	.....	.....	7.91	
Durham	.....	.....	.....	3.60	
Glendora	.....	.....	.....	0.00	
Jolon	.....	.....	.....	1.03	
Kernville	.....	.....	.....	0.00	
Lowe Obs'y	.....	.....	.....	0.00	
Merced	92	38	61.5	2.99	
Colorado.					
La Porte	.....	.....	.....	0.35	
Iowa.					
Sigourney	80	25	54.0	0.42	T.
Louisiana.	°	°	°	*Ins.*	*Ins.*
Cheneyville	94	35	67.2	0.00	
Maine.					
Grant Farm	.....	.....	.....	2.72	
Minnesota.					
Milaca	76	19	45.2	5.47	
Nebraska.					
Arcadia	.....	.....	.....	4.71	
York	.....	.....	.....	2.70	
New Hampshire.					
Bartlett	.....	.....	.....	3.11	
New Jersey.					
Chester	78	21	49.3	4.94	T.
Ohio.					
Findlay	83	24	51.6	1.45	
Granville	84	23	52.4	2.49	
Greenville	81	24	51.6	0.45	
Norwalk	81	21	51.8	2.54	T.
Pomeroy	87	23	53.4	0.97	
Texas.					
Kopperl	.....	.....	.....	6.90	
Mexico.					
Coatzacoalcos	87	65	77.7	21.88	
Vera Cruz	88	67	77.8	3.70	
Porto Rico.					
Caguas	91	62	77.1	9.85	
Isabela	88	69	78.3	3.59	
La Ysolina	89	65	77.2	6.36	

EXPLANATION OF SIGNS.

* Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance, "[n]" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks of whatever duration, in the precipitation record receive appropriate notice.

CORRECTIONS.

March, 1904, Pennsylvania, Greensboro, make precipitation 4.72 instead of 4.60. October, 1904, Louisiana, Farmersville, make mean temperature 68.4[f] instead of 67.3*. Montana, Hamilton, make mean temperature read 48.8 instead of 49.0. Tennessee, Mountain City should read Silver Lake. Texas, Runge, make mean temperature read 72.4 instead of 72.8. Ohio, Canton, make mean temperature read 49.8 instead of 48.6. November, 1904, page 525, under "Atmospheric Electricity," make number of thunderstorms read 144 instead of 159.

TABLE III.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of November, 1904.*

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	33	7	5	30	n. 44 w.	36
Portland, Me	27	11	3	33	n. 62 w.	34
Concord, N. H.†	16	7	6	9	n. 18 w.	10
Northfield, Vt	21	29	2	15	s. 58 w.	15
Boston, Mass	24	3	3	30	n. 52 w.	34
Nantucket, Mass	23	12	9	30	n. 62 w.	24
Block Island, R. I	26	9	8	29	n. 72 w.	22
Narragansett, R. I.*	9	6	3	19	n. 79 w.	16
Providence, R. I	30	8	6	34	n. 52 w.	36
Hartford, Conn	29	19	3	18	n. 56 w.	18
New Haven, Conn	32	12	9	24	n. 37 w.	25
Middle Atlantic States.						
Albany, N. Y	29	19	9	17	n. 39 w.	13
Binghamton, N. Y.†	11	3	13	12	n. 7 e.	8
New York, N. Y	25	7	10	32	n. 51 w.	28
Harrisburg, Pa	15	10	14	32	n. 80 w.	28
Philadelphia, Pa	28	10	11	28	n. 43 w.	25
Scranton, Pa	24	16	14	26	n. 34 w.	22
Atlantic City, N. J	28	8	5	32	n. 53 w.	34
Cape May, N. J	28	9	8	29	n. 48 w.	28
Baltimore, Md	31	7	7	29	n. 42 w.	32
Washington, D. C	23	10	10	30	n. 57 w.	24
Cape Henry, Va.†	11	12	5	8	s. 72 w.	3
Lynchburg, Va	22	11	9	34	s. 66 w.	27
Mount Weather, Va	25	14	8	30	n. 64 w.	25
Norfolk, Va	25	16	15	18	n. 18 w.	10
Richmond, Va	29	12	5	27	n. 52 w.	28
Wytheville, Va	12	10	8	40	n. 87 w.	32
South Atlantic States.						
Asheville, N. C	31	14	9	20	n. 22 w.	29
Charlotte, N. C	24	16	19	18	n. 7 e.	8
Hatteras, N. C	34	6	12	22	n. 20 w.	30
Raleigh, N. C	20	14	10	24	n. 41 w.	21
Wilmington, N. C	26	11	13	25	n. 39 w.	19
Charleston, S. C	23	12	16	22	n. 29 w.	12
Columbia, S. C	20	14	12	24	n. 37 w.	20
Augusta, Ga	26	9	12	31	n. 60 w.	34
Savannah, Ga	27	11	11	23	n. 34 w.	19
Jacksonville, Fla	24	14	14	22	n. 39 w.	13
Florida Peninsula.						
Jupiter, Fla	25	12	17	20	n. 13 w.	13
Key West, Fla	37	3	32	6	n. 38 e.	43
Sand Key, Fla.†	18	2	16	4	n. 37 e.	20
Tampa, Fla	31	3	23	20	n. 6 e.	28
Eastern Gulf States.						
Atlanta, Ga	25	12	13	27	n. 47 w.	19
Macon, Ga.†	18	4	3	11	n. 30 w.	16
Pensacola, Fla.†	14	1	11	9	n. 9 e.	13
Birmingham, Ala.†	15	5	8	10	n. 11 w.	10
Mobile, Ala	32	14	7	21	n. 38 w.	23
Montgomery, Ala	24	12	13	23	n. 40 w.	16
Meridian, Miss.†	15	4	10	11	n. 5 w.	11
Vicksburg, Miss	21	17	18	14	n. 45 e.	6
New Orleans, La	30	7	22	16	n. 15 e.	24
Western Gulf States.						
Shreveport, La	25	14	14	19	n. 24 w.	12
Fort Smith, Ark	17	10	21	20	n. 8 e.	7
Little Rock, Ark	27	16	10	24	n. 52 w.	18
Corpus Christi, Tex	31	8	22	12	n. 23 e.	25
Fort Worth, Tex	20	20	10	23	w.	13
Galveston, Tex	26	14	21	13	n. 34 e.	14
Palestine, Tex	22	17	12	21	n. 6 w.	10
San Antonio, Tex	27	20	15	12	n. 23 e.	8
Taylor, Tex.†	18	9	1	4	n. 18 w.	10
Ohio Valley and Tennessee.						
Chattanooga, Tenn	25	11	9	30	n. 56 w.	25
Knoxville, Tenn	26	12	15	23	n. 30 w.	16
Memphis, Tenn	25	14	17	18	n. 5 w.	11
Nashville, Tenn	26	12	13	27	n. 45 w.	20
Lexington, Ky.†	8	12	9	10	s. 14 w.	4
Louisville, Ky	23	19	9	21	n. 72 w.	13
Evansville, Ind.†	12	6	4	12	n. 53 w.	10
Indianapolis, Ind	20	21	7	23	s. 87 w.	16
Cincinnati, Ohio	17	20	14	25	s. 75 w.	11
Columbus, Ohio	13	26	9	28	s. 56 w.	23
Pittsburg, Pa	20	16	9	29	n. 79 w.	20
Parkersburg, W. Va	6	25	11	18	s. 20 w.	20
Elkins, W. Va	27	9	3	40	n. 64 w.	41
Lower Lake Region.						
Buffalo, N. Y	20	17	12	23	n. 75 w.	11
Oswego, N. Y	22	22	16	16	.....	.....
Rochester, N. Y	13	18	12	33	s. 77 w.	22
Syracuse, N. Y	14	16	8	31	s. 85 w.	23
Erie, Pa	13	29	8	24	s. 45 w.	23
Cleveland, Ohio	16	26	12	22	s. 45 w.	14
Sandusky, Ohio†	7	10	2	18	s. 79 w.	16
Toledo, Ohio	13	22	9	32	s. 69 w.	25
Detroit, Mich	20	14	6	33	n. 78 w.	28
Upper Lake Region.						
Alpena, Mich	22	16	8	28	n. 73 w.	21
Escanaba, Mich	28	14	8	23	n. 47 w.	20
Grand Rapids, Mich	18	24	12	20	s. 53 w.	10
Houghton, Mich.†	10	5	11	11	n.	5
Marquette, Mich	27	12	6	27	n. 55 w.	26
Port Huron, Mich	20	15	8	31	n. 78 w.	24
Sault Ste. Marie, Mich	24	15	19	16	n. 18 e.	10
Chicago, Ill	20	17	8	29	n. 75 w.	11
Milwaukee, Wis	20	13	5	31	n. 75 w.	27
Green Bay, Wis	18	21	7	27	s. 81 w.	20
Duluth, Minn	23	8	11	34	n. 57 w.	28

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
North Dakota.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Moorhead, Minn	23	21	7	22	n. 82 w.	15
Bismarck, N. Dak	24	12	14	24	n. 40 w.	16
Williston, N. Dak	15	22	12	26	s. 63 w.	16
Upper Mississippi Valley.						
Minneapolis, Minn.*	8	8	7	12	w.	5
St. Paul, Minn	19	22	12	21	s. 72 w.	10
La Crosse, Wis.†	10	13	7	5	s. 34 e.	4
Madison, Wis	17	18	8	29	s. 87 w.	21
Charles City, Iowa	17	21	14	26	s. 72 w.	13
Davenport, Iowa	17	16	7	34	n. 88 w.	27
Des Moines, Iowa	19	17	6	34	n. 86 w.	28
Dubuque, Iowa	19	21	5	27	s. 85 w.	22
Keokuk, Iowa	18	24	6	24	s. 72 w.	19
Cairo, Ill	28	20	10	15	n. 32 w.	9
Springfield, Ill	14	24	7	28	s. 65 w.	23
Hannibal, Mo.†	11	12	5	19	s. 86 w.	14
St. Louis, Mo	23	18	13	19	n. 50 w.	8
Missouri Valley.						
Columbia, Mo.*	5	9	7	12	s. 51 w.	6
Kansas City, Mo	21	19	12	22	n. 79 w.	10
Springfield, Mo	29	19	12	13	n. 6 w.	10
Topeka, Kans.*	11	12	3	11	s. 83 w.	8
Lincoln, Nebr	18	29	5	18	s. 50 w.	17
Omaha, Nebr	22	24	5	23	s. 84 w.	18
Valentine, Nebr	19	13	6	54	n. 83 w.	48
Sioux City, Iowa†	11	13	5	9	s. 63 w.	4
Pierre, S. Dak	23	16	24	21	n. 23 e.	8
Huron, S. Dak	22	18	12	22	n. 68 w.	11
Yankton, S. Dak.†	7	9	5	17	s. 81 w.	12
Northern Slope.						
Havre, Mont	19	15	16	28	n. 72 w.	13
Miles City, Mont	14	20	11	25	s. 67 w.	15
Helena, Mont	7	27	2	43	s. 64 w.	46
Kalispell, Mont	10	21	7	34	s. 68 w.	29
Rapid City, S. Dak	23	6	4	41	n. 66 w.	41
Cheyenne, Wyo	25	10	2	37	n. 67 w.	38
Lander, Wyo	14	23	15	23	s. 12 w.	42
Yellowstone Park, Wyo	5	38	1	30	s. 42 w.	44
North Platte, Nebr	15	19	6	35	s. 32 w.	29
Middle Slope.						
Denver, Colo	15	32	11	11	s.	17
Pueblo, Colo	23	13	19	21	n. 11 w.	10
Concordia, Kans	14	24	7	21	s. 54 w.	17
Dodge, Kans	19	14	14	24	n. 63 w.	11
Wichita, Kans	28	22	11	14	n. 27 w.	7
Oklahoma, Okla	26	18	8	19	n. 54 w.	14
Southern Slope.						
Abilene, Tex	18	31	7	14	s. 28 w.	15
Amarillo, Tex	21	19	9	28	n. 84 w.	19
Southern Plateau.						
El Paso, Tex	24	4	17	29	n. 31 w.	23
Santa Fe, N. Mex	34	3	42	1	n. 53 e.	51
Flagstaff, Ariz	35	6	19	8	n. 21 w.	31
Phoenix, Ariz	11	7	37	16	n. 79 e.	21
Yuma, Ariz	36	4	27	5	n. 34 e.	39
Independence, Cal	23	17	6	31	n. 55 w.	30
Middle Plateau.						
Carson City, Nev	12	20	19	21	s. 6 w.	18
Winnemucca, Nev	36	5	29	9	n. 33 e.	37
Modena, Utah	4	0	13	45	n. 83 w.	32
Salt Lake City, Utah	21	15	19	22	n. 27 w.	7
Grand Junction, Colo	26	9	18	21	n. 10 w.	17
Northern Plateau.						
Baker City, Oreg	6	37	33	7	s. 40 e.	40
Boise, Idaho	16	21	17	23	s. 50 w.	8
Lewiston, Idaho†	6	5	13	9	n. 76 e.	4
Pocatello, Idaho	1	23	36	12	s. 48 e.	33
Spokane, Wash	12	24	29	9	s. 59 e.	28
Walla Walla, Wash	6	36	13	12	s. 2 e.	30
North Pacific Coast Region.						
North Head, Wash	4	28	35	6	s. 50 e.	38
Port Crescent, Wash.*	3	15	14	7	s. 74 e.	7
Seattle, Wash	13	28	28	8	s. 53 e.	25
Tacoma, Wash	12	33	1	29	s. 53 w.	35
Tatoosh Island, Wash	0	28	31	11	s. 36 e.	34
Portland, Oreg	10	29	18	19	s. 3 w.	19
Roseburg, Oreg	15	17	19	20	s. 27 w.	2
Middle Pacific Coast Region.						
Eureka, Cal	8	37	14	12	s. 4 e.	29
Mount Tamalpais, Cal	21	17	14	20	n. 56 w.	7
Red Bluff, Cal	27	17	14	13	n. 6 e.	10
Sacramento, Cal	23	16	25	11	n. 63 e.	16
San Francisco, Cal	26	10	3	29	n. 58 w.	30
Point Reyes Light, Cal.*	12	10	7	10	n. 56 w.	4
Southeast Farallon, Cal.*	.....	.....	.....	.....	.....	.....
South Pacific Coast Region.						
Fresno, Cal	24	9	24	15	n. 31 e.	18
Los Angeles, Cal	21	8	18	26	n. 32 w.	15
San Diego, Cal	37	4	14	20	n. 63 w.	7
San Luis Obispo, Cal	30	12	10	19	n. 18 w.	29
West Indies						
Grand Turk, W. I.†	9	7	19	2	n. 83 e.	17
Havana, Cuba†	7	6	18	4	n. 86 e.	14
Kingston, Jamaica†	25	1	5	1	n. 9 e.	24
Roseau, Dominica, W. I.†	14	4	19	4	n. 56 e.	18
San Juan, Porto Rico	5	34	29	7	s. 37 e.	36
Hamilton, Bermuda	22	14	6	32	n. 73 w.	27
Puerto Principe, Cuba	.....	.....	.....	.....	.....	.....
Santiago de Cuba, Cuba	.....	.....	.....	.....	.....	.....
Port of Spain, Trinidad†	.....	.....	.....	.....	.....	.....

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE IV.—*Thunderstorms and auroras, November, 1904.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	60	T.		1	4																	1	2	2										10	5	T.
		A.																																0	0	A.
Arizona	56	T.			2	2																												4	2	T.
		A.																																0	0	A.
Arkansas	57	T.																																0	0	T.
		A.																																0	0	A.
California	167	T.														2	1											1	1					5	4	T.
		A.																																0	0	A.
Colorado	70	T.										2																						2	1	A.
		A.																																0	0	T.
Connecticut	21	T.																																0	0	A.
		A.																																0	0	T.
Delaware	5	T.																																0	0	A.
		A.																																0	0	T.
Dist. of Columbia	4	T.																																0	0	A.
		A.																																0	0	T.
Florida	61	T.		4	4									5								1	8					1					23	6	T.
		A.																																0	0	A.
Georgia	67	T.			2																													2	1	T.
		A.																																0	0	A.
Idaho	34	T.															2	2											2	2				8	4	T.
		A.																																0	0	A.
Illinois	84	T.					1																					1						2	2	A.
		A.																																0	0	T.
Indiana	58	T.																																0	0	A.
		A.																																0	0	T.
Indian Territory	20	T.																																0	0	A.
		A.																																0	0	T.
Iowa	128	T.																1																1	1	A.
		A.																																0	0	T.
Kansas	88	T.																																1	1	A.
		A.																																0	0	T.
Kentucky	41	T.																																0	0	A.
		A.																																0	0	T.
Louisiana	46	T.																																0	0	A.
		A.																																0	0	T.
Maine	25	T.																																0	0	A.
		A.					2																											2	1	A.
Maryland	42	T.																																0	0	T.
		A.							1				1			1	1								1						1			6	6	A.
Massachusetts	48	T.									1				1																			2	2	T.
		A.																																0	0	A.
Michigan	106	T.																			1													1	1	T.
		A.															1	1	2															4	3	A.
Minnesota	67	T.																																0	0	T.
		A.																					2											0	0	A.
Mississippi	57	T.																																2	1	T.
		A.																																0	0	A.
Missouri	86	T.																																4	2	T.
		A.																							2	2								6	3	A.
Montana	54	T.																																0	0	T.
		A.			2	2	2																											6	2	A.
Nebraska	137	T.																																0	0	T.
		A.																			1						1							2	2	A.
Nevada	40	T.																																0	0	T.
		A.																																0	0	A.
New Hampshire	21	T.																																0	0	T.
		A.			2	2																												4	2	A.
New Jersey	48	T.										2																						2	1	T.
		A.																																0	0	A.
New Mexico	31	T.			2	1																												3	2	T.
		A.																																0	0	A.
New York	129	T.					2									1		1			6	7	1											15	4	T.
		A.																																3	2	A.
North Carolina	56	T.																																0	0	T.
		A.																																0	0	A.
North Dakota	48	T.					1											2	4	2	2							2			2			13	6	T.
		A.																													1			3	2	A.
Ohio	101	T.																																0	0	T.
		A.																																0	0	A.
Oklahoma	36	T.																																0	0	T.
		A.																																0	0	A.
Oregon	70	T.												2		4	2	8	2									4	13				35	7	T.
		A.																																0	0	A.
Pennsylvania	91	T.																																0	0	T.
		A.																																0	0	A.
Rhode Island	6	T.																																0	0	T.
		A.																																0	0	A.
South Carolina	51	T.	1																				3											4	2	T.
		A.																																0	0	A.
South Dakota	56	T.																					2											2	1	T.
		A.		1			2	1	1									5	1	1														10	7	A.
Tennessee	56	T.																																12	7	T.
		A.																																0	0	A.
Texas	126	T.	2		1	4	3		2													5							1		1		1	1	A.
		A.																																18	7	T.
Utah	64	T.																																0	0	A.
		A.																																0	0	T.
Vermont	12	T.																																0	0	A.
		A.																																0	0	T.
Virginia	40	T.																																0	0	A.
		A.																																0	0	T.
Washington	71	T.			1													4	1															6	3	A.
		A.																			1													1	1	T.
West Virginia	47	T.									1																							1	0	A.
		A.																																0	0	T.
Wisconsin	63	T.																																2	1	A.
		A.																1																1	1	T.
Wyoming	38	T.																																0	0	A.
		A.																																0	0	T.
Sums	2993	T.	3	5	16	7	3	0	2	0	2	0	2	7	1	7	5	14	3	0	7	14	13	5	0	0	0	8	16	2	1	1	0	144	....	T.
		A.	0	1	0	4	12	3	2	0	0	0	1	0	0	1	2	11	7	3	4	0	2	0	3	2	1	1	0	1	3	0	0	66	....	A.

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during November, 1904, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y.	13–14			0.64														0.10			
Alpena, Mich.	5			0.11														0.07			
Amarillo, Tex.	1			0.13														*			
Asheville, N. C.	2–5			1.29														0.15			
Atlanta, Ga.	22			0.65														0.24			
Atlantic City, N. J.	13			1.83														0.35			
Augusta, Ga.	12–13			1.20														*			
Baltimore, Md.	13–14			1.59														0.15			
Binghamton, N. Y.	5–6			0.16														*			
Birmingham, Ala.	21–22	5:05 p. m.	D. N.	1.34	8:12 p. m.	8:45 p. m.	0.41	0.05	0.12	0.18	0.33	0.48	0.65	0.72							
Bismarck, N. Dak.	9			0.03																	
Block Island, R. I.	13–14			1.36														0.34			
Boise, Idaho.	30			0.07														0.06			
Boston, Mass.	13–14			1.56														0.22			
Buffalo, N. Y.	30			0.27																	
Cairo, Ill.	4			0.15														0.04			
Cape Henry, Va.	12–13			0.73														0.10			
Charleston, S. C.	3			1.03														0.26			
Charlotte, N. C.	12–13			1.46														0.22			
Chattanooga, Tenn.	29			0.97														0.28			
Chicago, Ill.	9			0.28														0.20			
Cincinnati, Ohio.	9–10			0.34														0.07			
Cleveland, Ohio.	10			0.13														0.07			
Columbia, Mo.	9			0.11														0.05			
Columbia, S. C.	12–13			1.22														0.20			
Columbus, Ohio.	8			0.07														0.07			
Concord, N. H.	13–14			1.48														*			
Corpus Christi, Tex.	1–2			0.42														0.17			
Davenport, Iowa.	9–10			0.18														0.03			
Denver, Colo.	10			0.02																	
Des Moines, Iowa.	9–10			0.06														0.03			
Detroit, Mich.	20			0.08														0.07			
Dodge, Kans.	10–11			0.04																	
Dubuque, Iowa.	9–10			0.08														0.01			
Duluth, Minn.	8–9			0.11														*			
Eastport, Me.	24			0.60														0.14			
Elkins, W. Va.	12–14			0.58														*			
Erie, Pa.	26–27			0.13														*			
Escanaba, Mich.	28			0.28														*			
Evansville, Ind.	9–10			0.18														0.07			
Fort Smith, Ark.	2–3			0.18														0.04			
Fort Worth, Tex.	20			0.02																	
Fresno, Cal.	1–2			0.07														0.04			
Galveston, Tex.	29	5:15 a. m.	3:00 p. m.	2.73	7:45 a. m.	8:30 a. m.	0.69	0.09	0.22	0.31	0.44	0.51	0.65	0.70	0.81	0.91					
Grand Junction, Colo.	†																				
Grand Rapids, Mich.	26			0.03																	
Green Bay, Wis.	20			0.26														*			
Hannibal, Mo.	9–10			0.26														0.05			
Harrisburg, Pa.	13			0.38														0.09			
Hatteras, N. C.	4	12:50 p. m.	5:00 p. m.	1.00	3:15 p. m.	3:50 p. m.	0.26	0.07	0.14	0.20	0.29	0.40	0.50	0.61	0.68	0.71					
Huron, S. Dak.	9			0.10														0.07			
Indianapolis, Ind.	10			0.11														0.05			
Jacksonville, Fla.	12			1.31														0.33			
Jupiter, Fla.	10–11			1.69														0.36			
Kalispell, Mont.	21			0.19														0.05			
Kansas City, Mo.	9–10			0.19														0.04			
Key West, Fla.	1–2			4.94														*			
Knoxville, Tenn.	29			0.75														0.16			
La Crosse, Wis.	20			0.06														0.05			
Lewiston, Idaho.	25			0.07														0.02			
Lexington, Ky.	9–10			0.50														*			
Lincoln, Nebr.	9–10			0.28														*			
Little Rock, Ark.	20			0.89														0.21			
Los Angeles, Cal.	†																				
Louisville, Ky.	9–10			0.22																	
Lynchburg, Va.	12–13			0.92														0.04			
Macon, Ga.	12–13			1.15														0.15			
Memphis, Tenn.	20			0.78														0.14			
Meridian, Miss.	1–3			1.81														0.18			
Milwaukee, Wis.	9			0.07														0.40			
Minneapolis, Minn.	9–10			0.07														0.05			
Montgomery, Ala.	21–22			1.27																	
Nantucket, Mass.	13–14			1.09														0.38			
Nashville, Tenn.	3–4			1.26														0.28			
New Haven, Conn.	13–14			1.33														0.15			
New Orleans, La.	30			0.43														0.27			
New York, N. Y.	9			0.59														0.36			
Norfolk, Va.	12–13			1.21														0.38			
Northfield, Vt.	13–14			0.47														0.23			
North Head, Wash.	19–21			3.93														*			
Oklahoma, Okla.	11			0.04														0.31			
Omaha, Nebr.	9–10			0.10																	
Palestine, Tex.	20			0.38														0.03			
Parkersburg, W. Va.	10			0.11														0.30			
Pensacola, Fla.	21	8:05 p. m.	10:40 p. m.	1.37	9:10 p. m.	9:38 p. m.	0.18	0.09	0.38	0.62	0.94	1.06	1.12					0.11			
Philadelphia, Pa.	13–14			2.08																	
Pittsburg, Pa.	10			0.11														0.22			
Pocatello, Idaho.	15			0.01														0.06			
Portland, Me.	13–14			1.24																	
Portland, Oreg.	27			0.51														0.11			
Pueblo, Colo.	10			T.														0.30			
Raleigh, N. C.	4			2.60																	
Richmond, Va.	12–13			1.65														0.40			
Rochester, N. Y.	20			0.10														0.18			
Sacramento, Cal.	27			1.08														0.10			
St. Louis, Mo.	9–10			0.54														0.50			
St. Paul, Minn.	9–10			0.08														0.08			
Salt Lake City, Utah.	†																	0.04			
San Antonio, Tex.	1			0.09																	
San Diego, Cal.	†																	0.07			
Sandusky, Ohio.	10			0.09														0.04			

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
San Francisco, Cal	27			0.56														0.26			
Savannah, Ga	2-3			1.90														0.32			
Scranton, Pa	13-14			1.20														*			
Seattle, Wash	21-22			0.61														0.25			
Shreveport, La	20			0.38														0.18			
Spokane, Wash	19-20			0.33														0.06			
Springfield, Ill	9			0.02																	
Springfield, Mo	9-10			0.16														*			
Syracuse, N. Y	5			0.11														*			
Tampa, Fla	22	1:02 p. m.	3:05 p. m.	1.02	1:30 p. m.	2:15 p. m.	0.05	0.06	0.21	0.26	0.28	0.32	0.57	0.67	0.86	0.93					
Taylor, Tex	20			0.23														0.08			
Toledo, Ohio	10			0.03																	
Topeka, Kans	9			0.10														0.05			
Valentine, Nebr	8-9			0.17														*			
Vicksburg, Miss	29-30			1.20														0.37			
Washington, D. C	13			1.79														0.28			
Wichita, Kans	9			0.04														0.03			
Williston, N. Dak	30			0.03																	
Wilmington, N. C	3-4			0.84														0.26			
Wytheville, Va	3-4			0.44														0.17			
Yankton, S. Dak	9			0.09														0.05			
Havana, Cuba	9			1.44														0.62			
San Juan, Porto Rico	3	4:30 p. m.	6:05 p. m.	1.35	4:30 p. m.	5:20 p. m.	0.00	0.05	0.13	0.23	0.30	0.47	0.68	0.89	1.06	1.17	1.26				
Do	18	6:20 a. m.	9:30 p. m.	2.64	2:43 p. m.	3:33 p. m.	0.55	0.09	0.15	0.37	0.48	0.52	0.56	0.58	0.67	0.74	0.79				

*Self-register not working † No precipitation during month.

TABLE VI.—*Data furnished by the Canadian Meteorological Service, November, 1904.*

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Pressure, in inches. Sea level, reduced to mean of 24 hours.	Pressure, in inches. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Depth of snow.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F	29.59	29.73	—.21	37.6	+ 1.1	43.3	32.0	8.84	+3.27	0.1
Sydney, C. B. I	29.74	29.78	—.17	36.6	— 0.5	42.3	30.9	8.05	+2.61	4.5
Halifax, N. S	29.71	29.82	—.19	36.0	— 1.3	42.7	29.4	5.11	—0.55	1.0
Grand Manan, N. B	29.78	29.83	—.18	34.9	— 4.0	41.1	28.7	4.27	—1.35	2.2
Yarmouth, N. S	29.77	29.84	—.18	36.1	— 3.8	41.6	30.6	2.54	—2.02	2.6
Charlottetown, P. E. I	29.75	29.79	—.17	33.8	— 1.7	38.4	29.1	5.67	+1.70	4.6
Chatham, N. B	29.79	29.81	—.16	29.9	— 1.1	37.0	22.8	3.12	—0.63	19.3
Father Point, Que	29.86	29.88	—.08	26.5	— 2.4	31.4	21.5	2.50	—0.61	23.0
Quebec, Que	29.59	29.93	—.09	26.4	— 2.6	31.8	20.9	1.16	—2.60	7.9
Montreal, Que	29.74	29.96	—.07	29.7	— 2.1	35.0	24.4	1.44	—2.30	10.5
Rockliffe	29.36	29.91	—.10	27.0	— 2.1	33.9	20.2	1.83	—0.75	7.0
Ottawa, Ont	29.61	29.95	—.07	29.8	— 1.9	35.4	24.2	0.91	—1.63	5.4
Kingston, Ont	29.65	29.97	—.07	33.1	— 1.9	40.4	25.8	0.79	—2.45	4.6
Toronto, Ont	29.60	29.99	—.05	35.9	+ 0.3	43.2	28.6	0.11	—3.03	0.3
White River, Ont	28.65	30.00	+.02	25.6	+ 5.1	32.4	18.7	0.92	—0.93	7.5
Port Stanley, Ont	29.35	30.01	—.04	36.8	0.0	45.2	28.3	0.39	—2.98	1.1
Saugeen, Ont	29.26	29.98	—.04	36.6	+ 1.6	44.9	28.3	1.14	—2.56	6.6
Parry Sound, Ont	29.21	29.97	—.04	32.6	+ 0.5	40.1	25.1	1.39	—2.98	4.0
Port Arthur, Ont	29.29	30.02	+.02	30.9	+ 6.9	37.4	24.4	0.58	—0.75	4.3
Winnipeg, Man	29.18	30.05	+.01	32.0	+14.0	41.3	22.6	0.32	—0.76	3.2
Minnedosa, Man	28.18	30.04	.00	32.2	+14.9	42.3	22.0	0.68	—0.32	6.8
Qu'Appelle, Assin	27.71	30.00	.00	33.8	+15.0	44.0	23.6	0.74	—0.15	7.4
Medicine Hat, Assin	27.66	29.96	—.04	41.5	+14.1	54.2	28.8	T.	—0.92	0.0
Swift Current, Assin	27.40	30.01	—.01	37.4	+14.2	49.0	25.9	0.13	—0.56	1.3
Calgary, Alberta	26.46	29.95	—.03	35.5	+ 9.7	47.5	23.5	0.20	—0.68	2.0
Banff, Alberta	25.34	29.98	+.02	35.9	+10.1	43.3	28.5	0.90	—1.37	6.7
Edmonton, Alberta	27.56	29.88	—.09	35.7	+12.8	46.8	24.7	0.16	—0.42	1.6
Prince Albert, Sask	28.34	29.93	—.10	29.8	+14.4	38.9	20.6	0.53	—0.30	5.2
Battleford, Sask	28.22	30.00	—.02	31.6	+15.3	42.3	20.8	0.12	—0.46	1.2
Kamloops, B. C	28.69	29.92	—.04	44.5	+11.1	51.3	37.8	0.44	—1.02	1.0
Victoria, B. C	29.83	29.93	—.06	49.1	+ 5.9	52.7	45.4	5.23	—1.74	0.0
Barkerville, B. C	25.53	29.86	—.04	34.1	+10.5	40.4	27.9	0.92	—2.37	5.0
Hamilton, Bermuda	29.87	30.03	—.02	66.1	— 2.6	70.8	61.4	2.60	—1.78	

TABLE VII.—*Heights of rivers referred to zeros of gages, November, 1904.*

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Milk River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Havre, Mont	237	9	3.1	18,19	2.8	1,4	2.9	0.3
James River.								
Huron, S. Dak. (2)	139	9	0.6	{1-11, 16-}{29, 25-28}	0.5	{12-15,}{21-24}	0.6	0.1
Republican River.								
Clay Center, Kans	42	18	6.7	3,7,27	6.5	6,13,15-17	6,6	0,2
Kansas River.								
Manhattan, Kans	160	18	3.2	1,15,16	2,9	10-14	3.0	0.3
Topeka, Kans	87	21	6.4	1,6,7,17-19	6.2	5,10-12,30	6.3	0.2
Missouri River.								
Bismarck, N. Dak	1,309	14	1.0	20-22	— 0.1	30	0.4	1.1
Pierre, S. Dak	1,114	14	1.9	2-4,9	1.4	30	1.8	0.5
Sioux City, Iowa	784	19	4.9	10-12,16-30	4.6	1-6	4.8	0.3
Blair, Nebr	705	15	4.5	17-22	4.2	3-7	4.4	0.3
St. Joseph, Mo	481	10	0.8	1	0.2	27-30	0.3	0.6
Kansas City, Mo	388	21	6.8	1,2	6.1	10-12,20	6.3	0.7
Glasgow, Mo	231	18	2.8	1,2	1.3	11	1.9	1.5
Boonville, Mo	199	20	6.2	1	5.2	24-30	5.6	1,0
Hermann, Mo	103	24	3.9	1	4.7	30	5.1	1.2
Minnesota River.								
Mankato, Minn	127	18	2.6	1	2.2	27-30	2.4	0.4
St. Croix River.								
Stillwater, Minn. (2)	23	11	8.9	1	4.0	29	5.3	4.9
Red Cedar River.								
Cedar Rapids, Iowa	77	14	3.0	2-6,8,18	2.6	30	2.8	0.4
Iowa River.								
Iowa City, Iowa	57	.....	— 1.1	9,16,20	— 1.7	26	—1.3	0.6
Illinois River.								
Peoria, Ill	135	14	8.0	1,5,24	7.8	{7-9,12,23}{29,30}	7.9	0.2
Red Bank Creek.								
Brookville, Pa	35	8	— 0.4	1-30	— 0.4	1-30	—0.4	0.0
Clarion River.								
Clarion, Pa	32	10	0.9	1	— 0.4	20-22,26,27	0.0	1.3
Conemaugh River.								
Johnstown, Pa	64	7	0.5	30	0.2	16-29	0.3	0.3
Allegheny River.								
Warren, Pa	177	14	1.4	1	0.0	23-28	0.4	1.4
Oil City, Pa	123	13	1.5	1	0.4	26-30	0.8	1.1
Parker, Pa	73	20	1.4	1,2	0.2	29,30	0.6	1.2
Freeport, Pa	29	20	2.9	1	1.0	30	1.6	1.9
Cheat River.								
Rowlesburg, W. Va	36	14	0.9	24	0.0	8,9	0.5	0.9
Youghiogheny River.								
Confluence, Pa	59	10	— 0.7	1-30	— 0.7	1-30	—0.7	0.0
West Newton, Pa	15	23	0.0	1-30	0.0	1-30	0.0	0.0
Monongahela River.								
Weston, W. Va	161	18	— 2.4	1-30	— 2.4	1-30	—2.4	0.0
Fairmont, W. Va	119	25	12.5	3	10.5	25	11.3	2.0
Greensboro, Pa	81	18	6.2	3	5.4	26,28-30	5.7	0.0
Lock No. 4, Pa	40	28	6.9	30	4.9	19-23	5,4	2.8

TABLE VII.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Beaver River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Ellwood Junction, Pa	10	14	1.2	12-17, 29	1.1	{1-11, 18-} {28, 30}	1.1	0.1
Muskingum River.								
Zanesville, Ohio	70	25	7.5	{1-13, 15-} {26, 29, 30}	74	14, 27, 28	7.5	0.1
Little Kanawha River.								
Glenville, W. Va	77	20	0.4	30	— 1.0	2	—0.3	1.4
Creston, W. Va	38	20	— 0.8	1-30	— 0.8	1-30	—0.8	0.0
Great Kanawha, River.								
Charleston, W. Va	58	30	7.2	19-30	6.8	1-10, 13, 14	7.0	0.4
New River.								
Radford, Va	155	14	— 1.5	16-21	— 2.0	3-7	—1.7	0.5
Hinton, W. Va	95	14	1.3	8, 16, 17	0.8	1-6	1.0	0.5
Scioto River.								
Columbus, Ohio	110	17	1.8	1, 4, 8-10	1.4	25, 27-30	1.6	0.4
Licking River.								
Falmouth, Ky	30	25	0.2	11-30	0.0	1, 2	0.2	0.2
Miami River.								
Dayton, Ohio	77	18	0.6	11	0.4	{1, 2, 4, 5, 14, 15, 21-23, 27-29}	0.5	0.2
Kentucky River.								
Jackson, Ky	287	24	2.4	30	0.6	1, 2, 6-9	1.2	1.8
Beattyville, Ky	254	30	— 0.5	29, 30	— 1.7	1-20	—1.4	1.2
High Bridge, Ky	117	17	8.3	1-10	8.1	11-30	8.2	0.2
Frankfort, Ky	65	31	5.1	1	4.1	26-30	4.6	1.0
Wabash River.								
Mount Carmel, Ill	75	15	0.8	1	0.5	9-12	0.7	0.3
Cumberland River.								
Burnside, Ky	518	50	1.5	23, 24	— 0.2	1-4	1.0	1.7
Celina, Tenn	383	45	0.7	11, 13, 14	0.0	1-4	0.4	0.7
Carthage, Tenn	308	40	0.3	17, 22	— 0.2	1-3	0.1	0.5
Nashville, Tenn	193	40	6.9	{9-13, 18-} {21, 23-29}	6.6	1.2	6.8	0.3
Powell River.								
Tazewell, Tenn	44	20	0.5	30	0.0	1-3	0.2	0.5
Clinch River.								
Speers Ferry, Va	156	20	— 0.4	25, 30	— 1.2	3	—0.4	0.8
Clinton, Tenn	52	25	3.4	25-27, 30	2.2	1, 2	2.8	1.2
Holston River.								
Bluff City, Tenn	170	15	0.5	14, 15	— 0.1	1	0.2	0.6
Rogersville, Tenn	103	14	1.5	15, 16	1.0	1-3	—1.3	0.5
French Broad River.								
Asheville, N. C	144	6	0.0	5	— 2.0	1-3	—1.6	2.0
Leadvale, Tenn	70	15	— 0.6	23	— 1.7	2	—1.1	1.1
Hiwassee River.								
Charleston, Tenn	18	22	0.6	24	— 0.1	1, 2	0.2	0.7
Tennessee River.								
Knoxville, Tenn	635	29	0.6	17	— 0.3	1-3	0.1	0.9
Loudon, Tenn	590	25	0.6	13, 14, 30	— 1.1	2	0.0	1.7
Kingston, Tenn	556	25	0.9	18, 19, 25, 26	0.3	1-5	0.3	0.6
Chattanooga, Tenn	452	33	1.1	20, 27	0.1	1, 2	0.8	1.0
Bridgeport, Ala	402	24	0.4	27, 28	— 0.4	1, 2	0.1	0.8
Florence, Ala	255	16	0.0	23-25	— 0.9	1-3	0.2	0.9
Riverton, Ala	225	26	0.9	26, 27, 30	— 0.5	1, 2	0.3	1.4
Johnsonville, Tenn	95	21	0.0	26-30	— 0.9	1-4	—0.4	0.9
Ohio River.								
Pittsburg, Pa	966	22	6.3	4, 5	5.3	23	5.9	1.0
Davis Island Dam, Pa	960	25	3.4	1	1.9	24, 26-30	2.4	1.5
Beaver Dam, Pa	925	27	4.0	1	2.2	24-27	2.7	1.8
Wheeling, W. Va	875	36	3.9	1	1.3	27	2.2	2.6
Parkersburg, W. Va	785	36	4.5	1	1.7	30	2.7	2.8
Point Pleasant, W. Va	703	39	2.4	1	1.0	26-30	1.4	1.4
Huntington, W. Va	660	50	5.3	1	3.3	30	3.9	2.0
Cailettsburg, Ky	651	50	3.3	1	1.3	25-27, 29, 30	1.8	2.0
Portsmouth, Ohio	612	50	4.3	2	2.4	{17-19, 26-} {28, 30}	2.9	1.9
Maysville, W. Va	559	50	4.1	3	2.5	18-20, 26-30	2.9	1.6
Cincinnati, Ohio	499	50	5.5	4	3.7	23, 28-30	4.2	1.8
Madison, Ind	413	46	4.2	7, 8	3.0	1-3	3.7	1.2
Louisville, Ky	367	28	3.1	7-10	2.2	29, 30	2.6	0.9
Evansville, Ind	184	35	2.3	12	1.3	26-30	1.7	1.0
Mount Vernon, Ind	148	35	1.6	12-15	0.6	28, 30	1.1	1.0
Paducah, Ky	47	40	0.7	14-17	0.2	1-3	0.4	0.5
Cairo, Ill	1	45	9.4	3-6	6.1	30	8.2	3.3
St. Francis River.								
Marked Tree, Ark	104	17	1.9	3-5	1.2	26-30	1.5	0.7
Neosho River.								
Neosho Rapids, Kans	326	22	0.3	23	0.0	7, 8, 10	0.2	0.3
Iola, Kans	262	10	0.4	21, 22	0.1	2-9	0.2	0.3
Oswego, Kans	184	20	0.4	6	0.1	3, 4, 13-16	0.2	0.3
Fort Gibson, Ind. T	3	22	9.5	10	9.0	22-30	9.2	0.5
Canadian River.								
Calvin, Ind. T	99	10	0.0	28-30	— 0.7	1-27	—0.6	0.7
Black River.								
Blackrock, Ark	67	12	1.4	3-30	1.2	1, 2	1.4	0.2
White River.								
Calicorock, Ark	272	15	— 0.6	1-3	— 0.7	4-30	—0.7	0.1
Batesville, Ark	217	18	2.2	1-9, 24-30	1.7	18-29	2.1	0.5
Newport, Ark	185	26	0.3	1-4, 6-10	0.0	22-25	0.2	0.3
Arkansas River.								
Wichita, Kans	832	10	0.9	1-3	0.4	26-30	0.6	0.5
Tulsa, Ind. T	551	16	2.2	1, 2	1.9	29-30	2.0	0.3
Webbers Falls, Ind. T	465	23	3.8	1, 2	3.0	9-30	3.1	0.8
Fort Smith, Ark	403	22	3.0	2	2.3	16, 30	2.5	0.7
Dardanelle, Ark	256	21	2.8	1-7	2.1	28-30	2.4	0.7
Little Rock, Ark	176	23	4.6	1	3.6	19, 20, 22-30	3.8	1.0
Yazoo River.								
Greenwood, Miss	175	38	0.3	28	— 0.1	1, 2, 14-17	0.0	0.4
Yazoo City, Miss	80	25	— 2.8	1-15, 22-25	— 3.0	16-21, 26-30	—2.9	0.2
Ouachita River.								
Camden, Ark	304	39	4.4	28, 29	3.1	1-5	3.5	1.3
Monroe, La	122	40	2.1	26	0.3	1, 5, 6	0.9	1.8
Red River.								
Arthur City, Tex	688	27	6.8	3	4.3	26	5.2	2.5
Fulton, Ark	515	28	5.7	3, 4	4.7	26	5.1	1.0
Springbank (2)	441	29	4.0	10	3.3	26-30	3.5	0.7
Shreveport, La	327	29	— 0.7	1, 2, 7-10	— 1.3	19, 20, 28-30	—1.0	0.6
Red River—Cont'd.								
Alexandria, La	118	33	— 0.3	4	— 1.3	29, 30	—0.9	1.6
Mississippi River.								
St. Cloud, Minn (2)	2,034	4	1.5	1	0.4	23-26	0.9	1.1
St. Paul, Minn	1,954	14	6.5	1	3.4	30	4.5	3.1
Red Wing, Minn	1,914	14	7.0	1	2.2	30	4.2	4.8
Reeds Landing, Minn	1,884	12	6.4	1	2.4	30	4.1	4.0
La Crosse, Wis	1,819	12	8.1	1	3.5	30	5.5	4.6
Prairie du Chien, Wis	1,759	18	9.1	1	4.0	30	6.4	5.1
Dubuque, Iowa	1,699	18	9.6	1	4.4	30	6.9	5.2
Clinton, Iowa	1,629	16	8.8	1	4.2	28-30	6.6	4.6
Leclaire, Iowa	1,609	10	5.9	1	2.1	29, 30	4.2	3.8
Davenport, Iowa	1,593	15	7.8	1, 2	3.8	29, 30	5.9	4.0
Muscatine, Iowa	1,562	16	8.8	1	4.5	29, 30	6.8	4.3
Galland, Iowa	1,472	8	4.2	1, 2	2.0	29, 30	3.2	2.2
Keokuk, Iowa	1,463	15	7.1	1	2.8	30	5.3	4.3
Warsaw, Ill	1,458	18	9.8	1	5.7	30	8.0	4.1
Hannibal, Mo	1,402	13	8.2	1	4.0	29, 30	6.3	4.2
Grafton, Ill	1,306	23	9.6	1-3	6.4	28-30	8.2	3.2
St. Louis, Mo	1,264	30	9.9	1	5.0	30	7.6	4.9
Chester, Ill	1,189	30	8.9	1-3	5.1	30	7.2	3.8
New Madrid, Mo	1,003	34	7.5	4, 5	4.7	30	6.4	2.8
Luxora, Ark	905	33	2.2	5, 6	0.1	30	1.3	2.1
Memphis, Tenn	843	33	5.0	6, 7	2.6	30	4.1	2.4
Helena, Ark	767	42	7.2	7, 8	4.6	30	6.1	2.6
Arkansas City, Ark	635	42	7.6	9, 10	4.9	30	6.5	2.7
Greenville, Miss	595	42	6.2	9, 10	3.9	30	5.3	2.3
Vicksburg, Miss	474	45	4.7	11	2.6	30	3.7	2.1
Natchez, Miss	373	46	7.6	12-14	6.2	2, 30	6.9	1.4
Baton Rouge, La	240	35	3.7	10	2.6	5, 6	3.3	1.1
Donaldsonville, La	188	28	3.5	3	2.1	21	2.8	1.4
New Orleans, La	108	16	4.8	2	3.2	6, 7, 17, 19	3.6	1.6
Atchafalaya River.								
Melville, La	103	31	5.6	11	4.8	1, 2	5.3	0.8
Penobscot River.								
Mattawamkeag, Me	87	.....	11.6	7, 8	10.2	17	10.9	1.4
Montague, Me	60	.....	4.7	1	3.2	30	3.9	1.5
Kennebec River.								
Winslow, Me	46	.....	4.7	1, 9, 23	3.4	17, 29	3.9	1.3
Merrimac River.								
Franklin Junction, N. H	110	.....	4.8	1-3	3.6	27	4.3	1.2
Concord, N. H. (2)	94	.....	1.4	6	0.6	28	1.1	0.8
Manchester, N. H	68	.....	3.8	6, 24	2.2	29	3.1	1.0
Connecticut River.								
Wells River, Vt. (1)	255	.....	25.0	1, 2	23.1	13, 14	24.1	1.9
Whiteriver Junction, Vt	209	.....	6.4	1	5.4	27	5.8	1.0
Bellows Falls, Vt	170	12	3.1	6	1.4	30	2.3	1.7
Holyoke, Mass	84	9	3.7	27	0.4	30	2.3	3.3
Hartford, Conn	50	13	4.1	1	1.9	29	3.0	2.2
Housatonic River.								
Gaylordsville, Conn	44	15	4.6	16, 23, 24	4.0	29	4.3	0.6
Mohawk River.								
Tribeshill, N. Y	42	15	1.5	22	— 0.1	4	0.6	1.6
Schenectady, N. Y (4)	19	15	1.9	21	1.0	27-30	1.4	0.9
Hudson River.								
Glens Falls, N. Y	197	.....	7.0	1	4.0	22	5.8	3.0
Troy, N. Y	154	14	4.9	6	2.0	14	3.1	2.9
Albany, N. Y	147	12	4.2	10	0.5	17	2.7	3.7
Pompton River.								
Pompton Plains, N. J	6	8	4.7	14	4.0	5	4.3	0.7
Passaic River.								
Chatham, N. J.	69	7	3.8	14	2.5	5-8, 28-30	2.8	1.3
Lehigh River.								
Mauchchunk, Pa	45	15	4.8	22-25	4.3	8-11	4.5	0.5
Schuylkill River.								
Reading, Pa	66	12	0.8	14	0.1	8-13	0.2	0.7
Delaware River.								
Hancock (E. Branch), N. Y	269	12	5.3	30	3.3	13	3.7	2.0
Hancock (W. Branch), N. Y	269	10	4.5	22	3.2	18, 19	3.7	1.3
Port Jervis, N. Y (3)	204	14	2.0	24	0.7	11-13	1.1	1.3
Phillipsburg, N. J	142	26	3.2	24	1.8	13	2.3	1.4
Trenton, N. J.	92	18	2.6	25, 26	1.3	13	1.9	1.3
North Branch Susquehanna.								
Binghamton, N. Y	183	16	3.8	23	2.6	20	3.0	1.2
Towanda, Pa	139	16	2.3	23	1.3	20-22	1.6	1.0
Wilkesbarre, Pa	60	17	5.5	25	4.2	14	4.6	1.3
West Branch Susquehanna.								
Lockhaven, Pa	65	12	— 2.0	1-30	— 2.0	1-30	—2.0	0.0
Williamsport, Pa	39	20	1.0	1-4	0.5	29, 30	0.7	0.5
Juniata River.								
Huntingdon, Pa	90	24	3.0	12	2.9	1-11, 13-30	2.9	0.1
Susquehanna River.								
Harrisburg, Pa	69	17	2.9	1	2.0	17	2.3	0.0
Shenandoah River.								
Riverton, Va	58	22	0.5	1-30	0.5	1-30	0.5	0.0
Potomac River.								
Cumberland, Md	290	8	1.0	1-30	1.0	1-30	1.0	0.0
Harpers Ferry, W. Va	172	18	— 1.4	14-16	— 2.5	4	—2.1	1.1
James River.								
Buchanan, Va	305	12	2.0	14	1.7	1-6	1.8	0.3
Lynchburg, Va	260	18	0.3	14-16	0.0	1-4	0.1	0.3
Columbia, Va	167	18	2.7	14	1.7	9	2.1	1.0
Richmond, Va	111	12	0.0	12	— 1.3	3, 8, 9	—0.5	1.3
Dan River.								
Danville, Va	55	8	0.0	13, 14	— 0.6	1-12	—0.4	0.6
Roanoke River.								
Weldon, N. C	129	30	15.0	15	8.2	1-3	9.2	6.8
Cape Fear River.								
Fayetteville, N. C	112	38	27.8	15	3.4	2, 3	9.9	24.4
Waccamaw River.								
Conway, S. C	40	7	3.0	13	1.0	14	2.2	2.0
Pedee River.								
Cheraw, S. C	149	27	13.5	15	1.7	2	3.6	11.8
Smiths Mills, S. C	51	16	10.0	19	2.0	3-5	5.7	8.0

TABLE VII.—*Heights of rivers referred to zeros of gages.*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Lynch Creek.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Effingham, S. C.	35	12	5.2	16	2.4	1–3	3.7	2.8
Black River.								
Kingstree, S. C.	45	12	3.6	30	0.3	1, 2	1.5	3.3
Catawba River.								
Mount Holly, N. C	28	15	2.3	14	1.0	2, 3	1.6	1.3
Wateree River.								
Camden, S. C.	37	24	13.0	15	3.2	1	5.3	9.8
Congaree River.								
Columbia, S. C	52	15	0.3	15	— 0.6	22, 30	—0.2	0.9
Santee River.								
St. Stephens, S. C.	50	12	5.9	18	— 1.7	6	1.0	7.6
Edisto River.								
Edisto, S. C.	75	6	2.9	23–26	1.3	1	2.1	1.6
Broad River.								
Carlton, Ga.	30	11	2.3	24	1.6	1, 2, 10–12	1.8	0.7
Savannah River.								
Calhoun Falls, S. C.	347	15	1.6	5	1.1	28	1.3	0.5
Augusta, Ga.	268	32	6.8	16	4.3	2	5.5	2.5
Oconee River.								
Milledgeville, Ga.	147	25	2.0	15	0.6	1, 2	1.4	1.4
Dublin, Ga	79	30	— 0.1	{15, 17, 18} {26–28}	— 1.2	2	—0.4	1.1
Ocmulgee River.								
Macon, Ga.	203	18	2.1	25	— 0.1	2	1.1	2.2
Abbeville, Ga.	96	11	1.8	18, 28	0.0	2	1.1	1.8
Flint River.								
Woodbury, Ga.	227	10	0.2	14, 15, 24, 25	— 0.4	1	0.0	0.6
Montezuma, Ga.	152	20	2.6	15	1.1	1, 2	2.0	1.5
Albany, Ga.	90	20	1.2	16	— 0.2	1, 2	0.7	1.4
Bainbridge, Ga	29	22	2.7	17, 18, 27, 28	1.4	1	2.3	1.3
Chattahoochee River.								
Oakdale, Ga.	305	18	0.0	1–30	0.0	1–30	0.0	0.0
West Point, Ga	239	20	1.8	15, 23–26	0.9	2	1.6	0.9
Eufaula, Ala	90	40	1.0	23, 24	— 0.5	1, 2	0.3	1.5
Alaga, Ala	30	25	1.8	24	0.1	1, 2	1.0	1.7
Coosa River.								
Rome, Ga.	271	30	0.2	15–17	— 0.9	1, 2	—0.2	1.1
Gadsden, Ala.	144	22	— 0.6	26	— 1.2	1	—0.8	0.6
Lock No. 4, Ala.	116	17	— 0.1	28	— 1.0	1, 2	—0.4	0.9
Wetumpka, Ala	6	45	1.2	26	— 0.5	1, 2	—0.2	1.7
Tallapoosa River.								
Milstead, Ala.	38	35	1.8	25, 26	0.1	7, 8	0.6	1.7
Alabama River.								
Montgomery, Ala.	265	35	— 0.4	25	— 1.9	1, 2	—1.3	1.5
Selma, Ala	212	35	— 0.6	25–28	— 1.8	1–3, 9, 10	—1.4	1.2
Black Warrior River.								
Tuscaloosa, Ala.	90	43	4.8	8	4.1	1, 2	4.5	0.7
Tombigbee River.								
Columbus, Miss	303	33	— 2.2	30	— 3.1	1	—2.5	0.9
Demopolis, Ala.	155	35	— 2.3	25	— 3.8	1	—2.8	1.5
Leaf River.								
Hattiesburg, Miss	60	20	2.7	4	2.3	{1, 2, 13–20} {27–30}	2.4	0.4
Chickasawhay River.								
Enterprise, Miss	144	18	0.0	1–30	0.0	1–30	0.0	0.0
Shubuta, Miss.	106	25	3.1	7, 8	2.0	5, 23, 30	2.5	1.1
Pearl River.								
Jackson, Miss	242	20	0.8	23, 30	0.3	1, 2	0.5	0.5
Sabine River.								
Logansport, La.	315	25	1.4	30	0.1	1, 2	0.7	1.3
Neches River.								
Rockland, Tex	105	20	— 0.3	30	— 0.8	1–19	—0.7	0.5
Beaumont, Tex.	18	10	1.6	2	— 0.3	11, 12	0.6	1.9
Trinity River.								
Dallas, Tex.	320	25	5.2	1	2.2	25, 26	2.7	3.0
Riverside, Tex.	112	40	3.1	4	— 0.7	1, 2	0.4	3.8
Liberty, Tex	20	25	5.0	8	3.3	17	3.9	1.7
Brazos River.								
Kopperl, Tex	345	21	1.6	1	0.0	26–30	0.6	1.6
Waco, Tex.	285	24	4.5	1	2.8	24–30	3.2	1.7
Hempstead, Tex	140	40	6.0	1	— 2.1	29, 30	—0.1	8.1
Booth, Tex	61	39	2.7	24	1.2	19, 20	1.9	1.5
Colorado River.								
Ballinger, Tex.	489	21	2.0	1	1.5	21–30	1.6	0.5
Austin, Tex.	214	18	2.5	1	1.2	28, 29	1.5	1.3
Columbus, Tex.	98	24	11.4	1	6.0	30	7.1	5.4
Guadalupe River.								
Gonzales, Tex.	112	22	0.9	1	0.5	12–14	0.6	0.4
Victoria, Tex	35	16	15.0	20	1.3	13, 14	2.3	13.7
Red River of the North.								
Moorhead, Minn.	284	26	8.1	1–4	7.0	29	7.9	1.1
Kootenai River.								
Bonners Ferry, Idaho	123	24	0.6	23–25	— 0.3	14–17	0.0	0.9
Pend d'Oreille River.								
Newport, Wash.	86	14	— 1.2	28–30	— 1.6	19	—1.4	0.4
Snake River.								
Lewiston, Idaho	144	24	2.1	20, 21, 25–27	1.9	14–17	2.0	0.2
Riparia, Wash	67	30	2.6	11–14	2.3	22–30	2.4	0.3
Columbia River.								
Wenatchee, Wash	473	40	5.5	1, 2	5.0	19–21	5.2	0.5
Umatilla, Oreg.	270	25	0.8	30	— 1.0	29	—0.3	1.8
The Dalles, Oreg.	166	40	2.0	21	0.7	12, 13	1.3	1.3
Willamette River.								
Eugene, Oreg.	183	10	3.4	18	1.8	1, 2	2.5	1.6
Albany, Oreg.	118	20	3.2	24	0.9	1	1.7	2.3
Salem, Oreg	84	20	5.1	21	0.3	1, 14, 15	1.6	4.8
Portland, Oreg.	12	15	6.2	22	0.6	2	3.1	5.6
Sacramento River.								
Red Bluff, Cal.	201	23	5.4	2	1.8	13, 14	3.2	3.6
Sacramento, Cal.	64	25	12.0	30	10.4	15	11.0	1.6

(1) Frozen for 16 days. (2) Frozen for 2 days. (3) For 21 days only. (4) For 27 days only.

HAWAIIAN CLIMATOLOGICAL DATA.

By ALEXANDER McC. ASHLEY, Section Director, United States Weather Bureau.

GENERAL SUMMARY FOR NOVEMBER, 1904.

Following is the summary of meteorological conditions in the Hawaiian Islands during November, 1904:

Approximate percentages of district rainfall as compared with normals: Hawaii, Hilo, 70; Hamakua, 142; Kohala, 140; Kona, 28; Kau, 11. Maui (East), 130. Oahu, Honolulu, 103; Nuuanu, 87; Koolau, 104; Ewa, 63. Kauai, Lihue, 43; Hanalei, 34; Waimea, 28.

The greatest monthly rainfall reported was 18.01 inches at Puuohua, Hawaii. The greatest 24-hour rainfall was 3.72 inches, on the 27th, at the United States Magnetic Station, Oahu.

Hawaii.—Pepeekeo reports solar halos on the 2d and 29th; light earthquake shock at 8 p. m. of the 13th; heavy fall of snow and hills covered on the 28th; snow disappeared by the 30th.

Niulii reports thunder on the 28th to northward of station.

Oahu.—United States Weather Bureau reports solar rainbows on various dates.

Temperature table for November, 1904.

Stations.	Elevation.	Mean max.	Mean min.	Cor. av'ge.	Highest.	Lowest.
	Feet.	°	°	°	°	°
Pepeekeo	100	78.0	68.0	73.0	82	65
Hakalau	200	77.0	66.0	72.0	81	62
Ookala	400	78.0	66.0	72.0	83	61
Kohala Mission	521	77.0	66.0	72.0	82	62
Niulii	200	78.0	69.0	73.0	82	64
Volcano House	4,000	70.0	51.0	60.0	75	47
Kau	1,850	78.0	58.0	68.0	83	52
Pahala	850	82.0	64.0	73.0	88	61
Olaa Mill	210	81.0	59.0	70.0	83	54
Kaanapali	12	82.0	66.0	74.0	87	61
Wailuku	250	81.0	66.0	74.0	85	55
Kihei	55	82.0	67.0	74.0	89	61
United States Weather Bureau	121	78.0	68.0	73.0	82	61
United States Magnetic Station	45	82.0	66.0	74.0	86	54
United States Experiment Station	350	80.0	68.0	74.0	84	60
Punahou	47	79.0	68.0	73.0	81	57
Ahuimanu	350	80.0	66.0	73.0	84	60
Waiawa	675	79.0	64.0	72.0	83	57
Ewa Mill	60	78.0	64.0	71.0	82	54
Kahuku	25	80.0	71.0	75.0	84	62
Lihue	200	81.0	65.0	73.0	85	50
Kilauea	342	78.0	65.0	72.0	82	56
Keatia	15	79.0	67.0	73.0	83	58
Koloa	241	80.0	67.0	74.0	84	54
Makaweli	140	84.0	67.0	75.0	88	57
Kaahoolawe	1,420	88.0	71.0	79.0	102	64

Honolulu, Hawaii, latitude, 21° 19′ north, longitude 157° 52′ west; barometer above sea, 38 feet; gravity correction, —.057 applied. November, 1904.

Day.	Pressure.*		Air temperature.				Moisture.				Wind.				Precipitation.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction.	Amount.	Kind.	Direction.
1	30.11	30.10	77.0	77.2	80	70	68.8	66	68.0	62	ne.	17	ne.	14	0.12	0.04	8	S.-cu.	ne.	5	S.-cu.	e.
2	30.11	30.10	78.2	73.3	80	73	69.0	63	70.0	85	ne.	14	nw.	8	0.00	0.04	2	Cu.	e.	10	N.	calm.
3	30.10	30.09	74.5	76.0	80	71	70.0	80	67.0	62	ne.	4	e.	7	0.14	0.03	9	N.	ne.	2	S.-cu.	e.
4	30.08	30.10	78.0	75.7	81	74	69.0	63	68.0	67	ne.	9	ne.	9	0.00	T.	2	Cu.	e.	7	N.	e.
5	30.06	30.06	77.4	75.0	82	73	68.4	63	67.0	66	e.	9	ne.	3	T.	0.00	3	Cu.	e.	1	S.-cu.	calm.
6	30.01	29.94	76.2	73.0	78	70	67.7	64	66.3	70	e.	3	ne.	2	0.00	0.00	few.	Cu.	e.	1	S.-cu.	calm.
7	29.92	29.89	75.4	72.7	78	67	66.9	64	68.0	79	w.	2	ne.	4	0.00	T.	3	Ci.-s.	w.	8	S.-cu.	e.
																	1	Cu.	calm.			
8	29.94	29.94	71.0	71.1	75	69	65.8	76	63.0	64	ne.	18	ne.	19	0.01	T.	9	N.	ne.	5	S.-cu.	ne.
9	29.99	29.96	74.0	72.0	79	68	64.0	58	64.3	66	ne.	1	ne.	5	0.00	0.00	2	Ci.-s.	calm.	2	S.-cu.	ne.
10	29.96	29.97	72.0	71.2	81	64	65.0	69	68.1	86	nw.	3	ne.	10	0.00	0.05	few.	Ci.-s	calm.	10	N.	calm.
11	29.97	29.96	74.2	73.0	78	69	64.7	60	65.0	65	ne.	12	ne.	8	T.	0.00	few.	Cu.	e.	few.	S.-cu.	calm
12	29.98	29.98	74.5	74.0	80	69	65.1	60	65.5	63	ne.	4	e.	5	0.00	0.00	2	Cu.	e.	few.	Cu.	ne.
13	30.02	30.01	76.0	75.2	80	71	65.0	55	65.2	58	e.	9	ne.	10	0.00	0.00	4	S.-cu.	e.	4	Cu.	e.
14	30.03	30.02	77.3	75.2	80	71	66.3	56	68.0	69	n.	3	ne.	7	0.00	0.00	4	S.-cu.	e.	7	Cu.	ne.
15	30.06	30.07	75.0	75.0	80	71	68.4	72	68.0	70	ne.	4	ne.	9	T.	T.	8	S.-cu.	ne.	6	Cu.	e.
																				3	N.	e.
16	30.11	30.11	75.4	74.5	79	68	67.0	64	67.5	70	ne.	9	e.	16	T.	T.	8	S.-cu.	e.	9	S.-cu.	e.
17	30.16	30.16	73.5	71.1	77	69	67.0	71	67.0	81	ne.	23	e.	9	0.06	0.14	10	S.-cu.	ne.	10	N.	calm.
18	30.13	30.11	74.5	74.0	79	67	67.0	68	68.0	74	ne.	20	e.	14	0.25	0.07	4	Cu.	e.	9	N.	e.
19	30.08	30.04	75.4	75.0	79	70	67.9	68	66.0	62	e.	9	ne.	7	0.01	T.	4	Cu.	e.	7	S.-cu.	e.
20	30.07	30.03	76.5	74.0	78	70	66.5	59	65.0	61	ne.	5	ne.	9	0.00	0.00	7	S.-cu.	e.	8	S.-cu.	e.
21	30.05	30.04	75.0	72.4	80	65	65.2	59	66.4	73	e.	2	ne.	10	0.00	0.01	1	S.-cu.	calm.	8	S.-cu.	ne.
22	30.04	30.05	72.1	71.5	76	65	62.6	59	65.0	70	ne.	16	ne.	9	0.27	T.	2	S.-cu.	e.	9	S.-cu.	ne.
23	30.03	29.95	72.5	72.0	77	66	65.8	70	62.0	57	ne.	5	ne.	6	0.00	0.00	8	S.-cu.	e.	8	S.-cu.	ne.
24	29.96	29.88	68.5	67.0	75	62	62.0	70	64.0	85	n.	2	ne.	5	0.00	T.	8	A.-cu.	calm.	8	N.	calm.
25	29.90	29.91	69.0	65.5	76	61	63.2	73	58.0	64	n.	3	ne.	4	T.	0.00	2	Ci.-s.	calm.	2	S.-cu.	calm.
26	29.92	29.92	68.8	72.0	75	61	60.8	63	65.0	69	ne.	2	e.	4	0.00	0.00	few.	A.-cu.	calm.	5	S.-cu.	calm.
27	29.92	30.00	76.0	69.3	76	66	73.0	87	67.0	89	s.	19	se.	5	0.26	1.36	10	S.-cu.	se.	10	N.	calm.
28	30.05	30.04	71.0	72.0	76	65	67.7	85	67.0	77	n.	12	ne.	18	1.22	0.03	10	N.	calm.	5	S.-cu.	ne.
29	30.02	29.99	76.0	73.3	80	70	69.8	73	69.3	82	e.	2	e.	4	0.00	0.00	8	Ci.-cu.	w.	10	S.-cu.	calm.
30	29.99	30.01	75.9	75.5	80	71	71.1	79	71.2	81	e.	4	se.	4	T.	T.	9	S.-cu.	s.	10	S.-cu.	calm.
31																						
Mean	30.026	30.014	74.4	73.0	78.5	68.2	66.7	67.2	66.3	70.9	ne.	8.2	ne.	8.1	2.34	1.77	4.9	S.-cu.	e.	6.3	S.-cu.	e.

Observations are made at 8 a. m. and 8 p. m., local standard time, which is that of 157° 30′ west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity

Rainfall data for November, 1904.

Stations.	Elevation.	Amount.
HAWAII.		
HILO, e. and ne.	*Feet.*	*Inches.*
Papaikou		8.91
Waiakea	50	5.19
Hilo (town)	100	5.78
Kaumana	1,050	7.86
Pepeekeo	100	6.79
Hakalau	200	9.16
Puuohua	1,050	18.01
Laupahoehoe	500	13.30
Ookala	400	9.58
Puueo	85	6.71
HAMAKUA, ne.		
Paauilo	300	8.24
Kukaiau	250	8.71
Honokaa (Meinicke)	1,100	14.50
Kukuihaele	700	8.99
KOHALA, n.		
Niulii	200	6.32
Kohala (Mission)	521	6.47
Kohala (Sugar Co.)	270	6.49
Hawi Mill	600	6.13
Puakea Ranch	600	4.71
Puuhue Ranch	1,847	5.87
Waimea	2,720	3.89
Awini Ranch	1,100	13.12
KONA, w.		
Huehue	2,000	0.15
Holualoa	1,350	1.08
HAWAII—*Cont'd.*		
Kealakekua	1,580	1.34
Kealakekua (Wallace)		1.27
Napoopoo	25	0.55
Puuwaawaa Ranch	2,736	0.33
KAU, se.		
Kau	1,850	1.97
Honuapo	25	0.55
Naalehu	650	0.70
Hilea	310	0.50
Pahala	850	0.12
Volcano House	4,000	2.21
Keaa Homesteads	2,000	1.98
PUNA, e.		
Olaa Mill	210	6.38
MAUI.		
Kaanapali	12	2.83
Kaupo (Mokulau), s	285	3.62
Kipahulu, s	308	3.73
Kihei	55	1.80
Nahiku, ne	850	11.25
Hahiku	700	6.43
Kula (Erehwon), n	4,000	2.65
Puuomalei, n	1,400	9.50
Paia	180	5.10
Haleakala Ranch	2,000	7.39
Wailuku, ne	250	6.07
Kahului	8	3.09
Makawao	1,700	10.79
MAUI—*Cont'd.*		
Puunene	73	5.32
OAHU.		
U. S. Weather Bureau	108	4.11
Punahou (W. B.), sw	47	6.36
Kulaokahua (Castle), sw	50	4.94
U. S. Naval Station, sw	6	4.25
College Hill s.	175	7.01
Manoa (Woodlawn Dairy), e	285	9.21
Manoa (Rhodes Gardens)	300	14.74
Insane Asylum	30	4.10
Kalihi-uka	485	8.54
Nuuanu (W. W. Hall), sw	50	4.38
Nuuanu (Wyllie street)	250	5.33
Nuuanu (Elec. Station), sw	405	5.30
Nuuanu (Luakaha), e	850	11.60
U. S. Experiment Station	350	5.45
Tantalus Heights (Frear)	1,360	10.19
Waimanalo, ne	25	6.37
Maunawili, ne	250	8.17
Kaneohe	100	4.88
Ahuimanu, ne	350	7.08
Kahuku	25	6.13
Ewa Plantation, s.	60	3.05
U. S. Magnetic Station	45	4.94
Moanalua	15	3.76
Waiawa	675	6.77
KAUAI.		
Wilcox Ditch	725	3.50
KAUAI—*Cont'd.*		
Mahaulepu	90	3.87
Koloa (Kukuiula)	100	2.68
Makawell	140	7.22
Lihue (Weber)	200	2.88
Lihue (Grove Farm), e	200	2.74
Lihue (Molokoa), e	250	2.90
Lihue (Kukaua), e	1,000	4.51
Kealia, e	15	1.87
Kilauea (Plantation), ne	342	2.62
Waiawa	30	1.10
Eleele	150	1.30
Wahiawa	150	1.77
McBryde	900	2.99
Lawai (Gov. Road)	450	3.96
Lawai, w	225	2.00
Lawai, e	800	3.77
Lawai Beach	5	3.22
Koloa	241	3.72
Hanamaulu	200	2.45
Olokele Valley	1,310	4.12
Halaula	250	2.05
Kapahi	300	3.30
Delayed October reports		
Ewa Plantation, Oahu	50	1.97
Haleakala Ranch, Maui	2,000	1.87
Hawi Mill, Hawaii	600	1.79

NOTE.—The letters n, s, e, w, and c show the exposure of the station relative to the winds.

Chart I. Tracks of Centers of High Areas. November, 1904. • Barkerville

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Chart I. Tracks of Centers of High Areas. November, 1904.

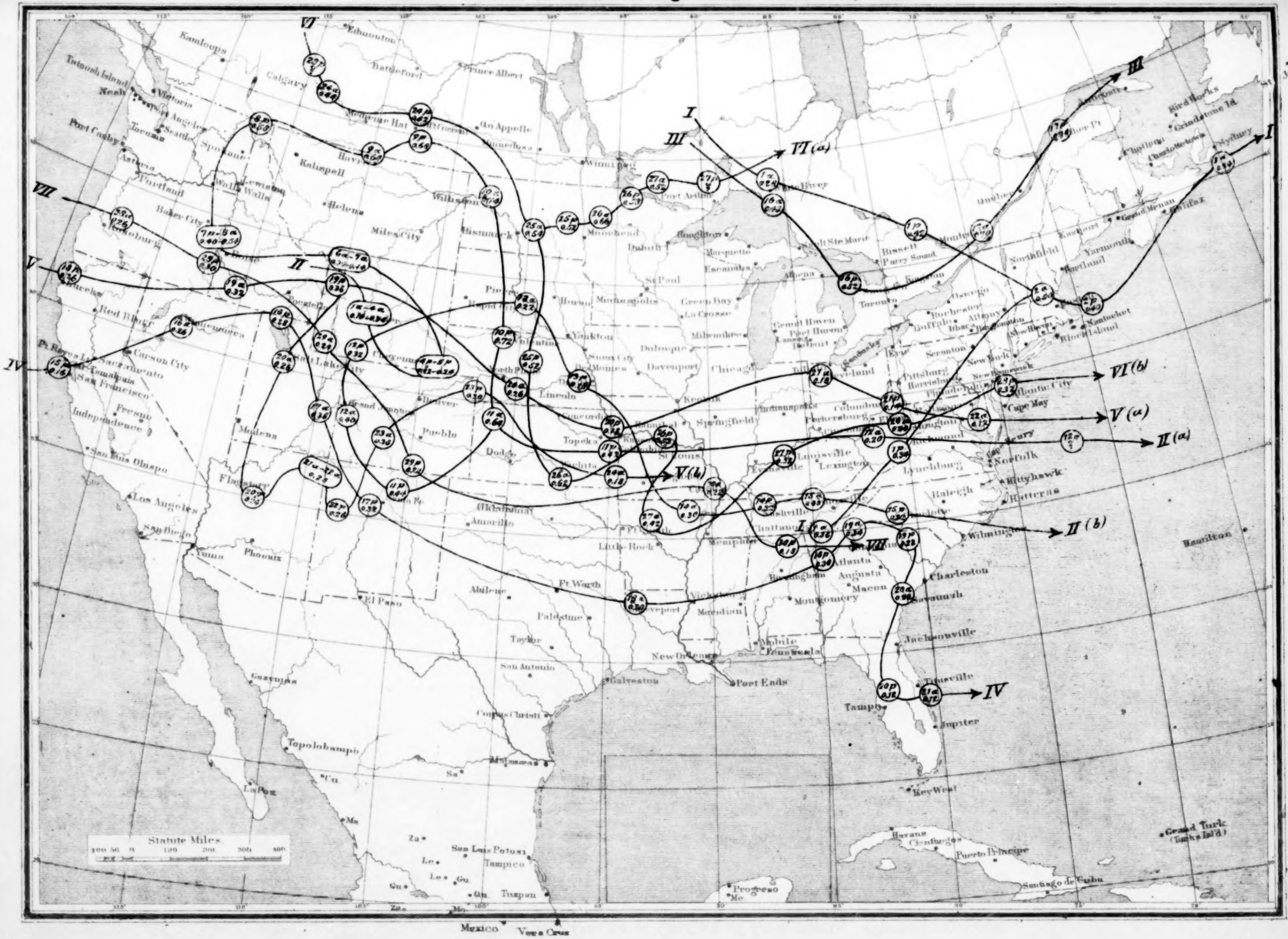

Chart II. Tracks of Centers of Low Areas. November, 1904.

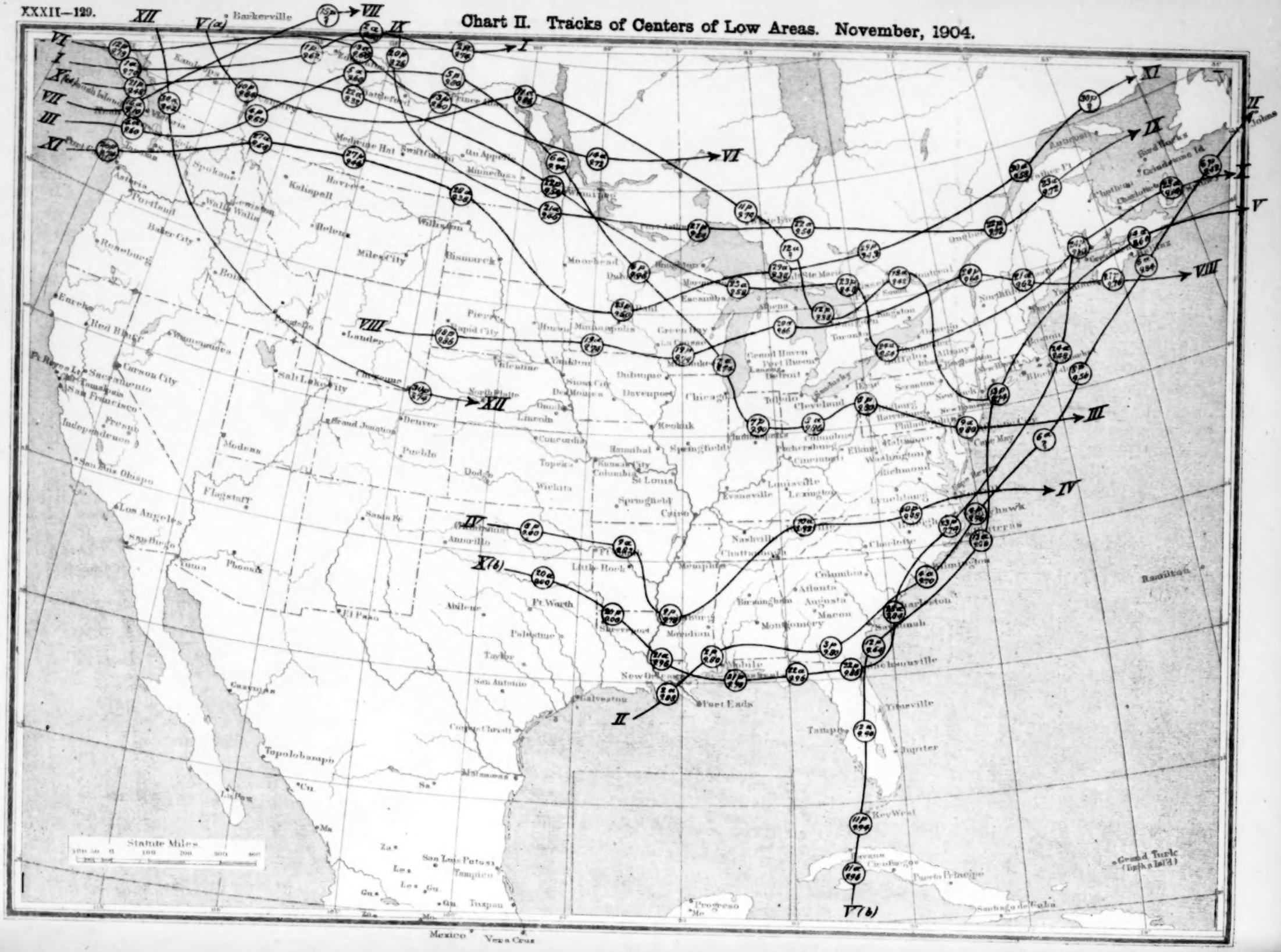

Chart III. Total Precipitation. November, 1904.

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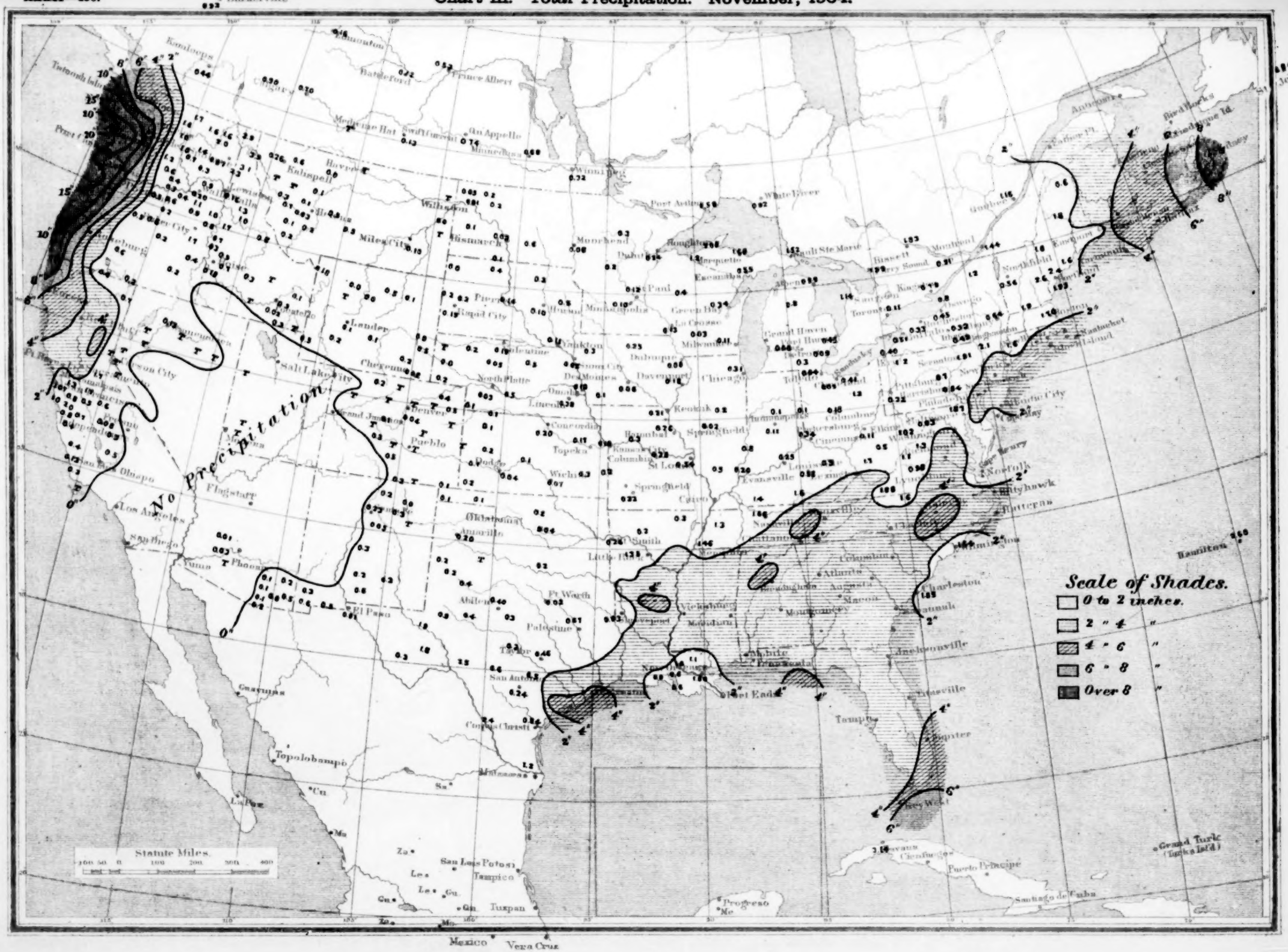


Chart IV. Percentage of Clear Sky. November, 1904.

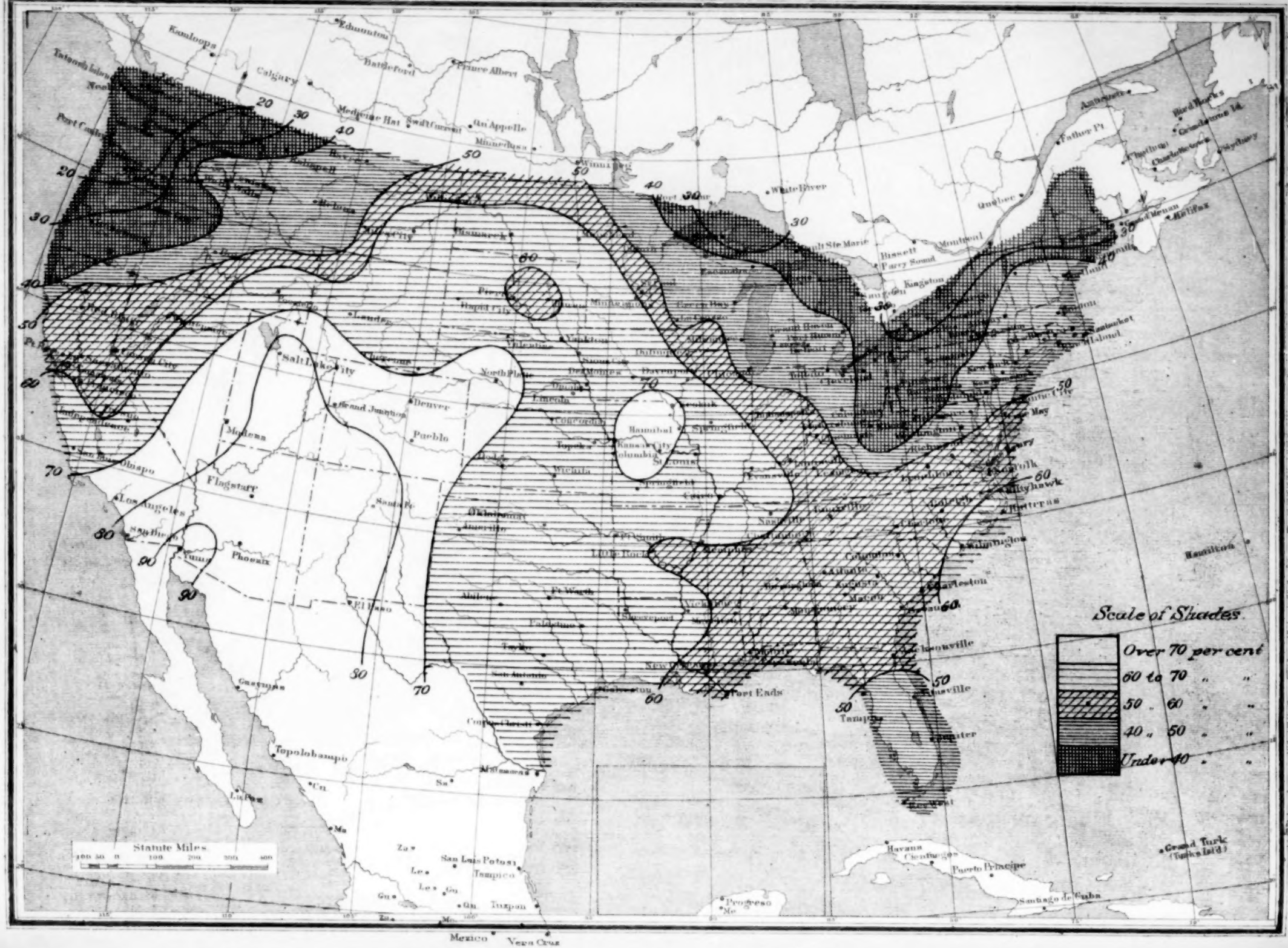
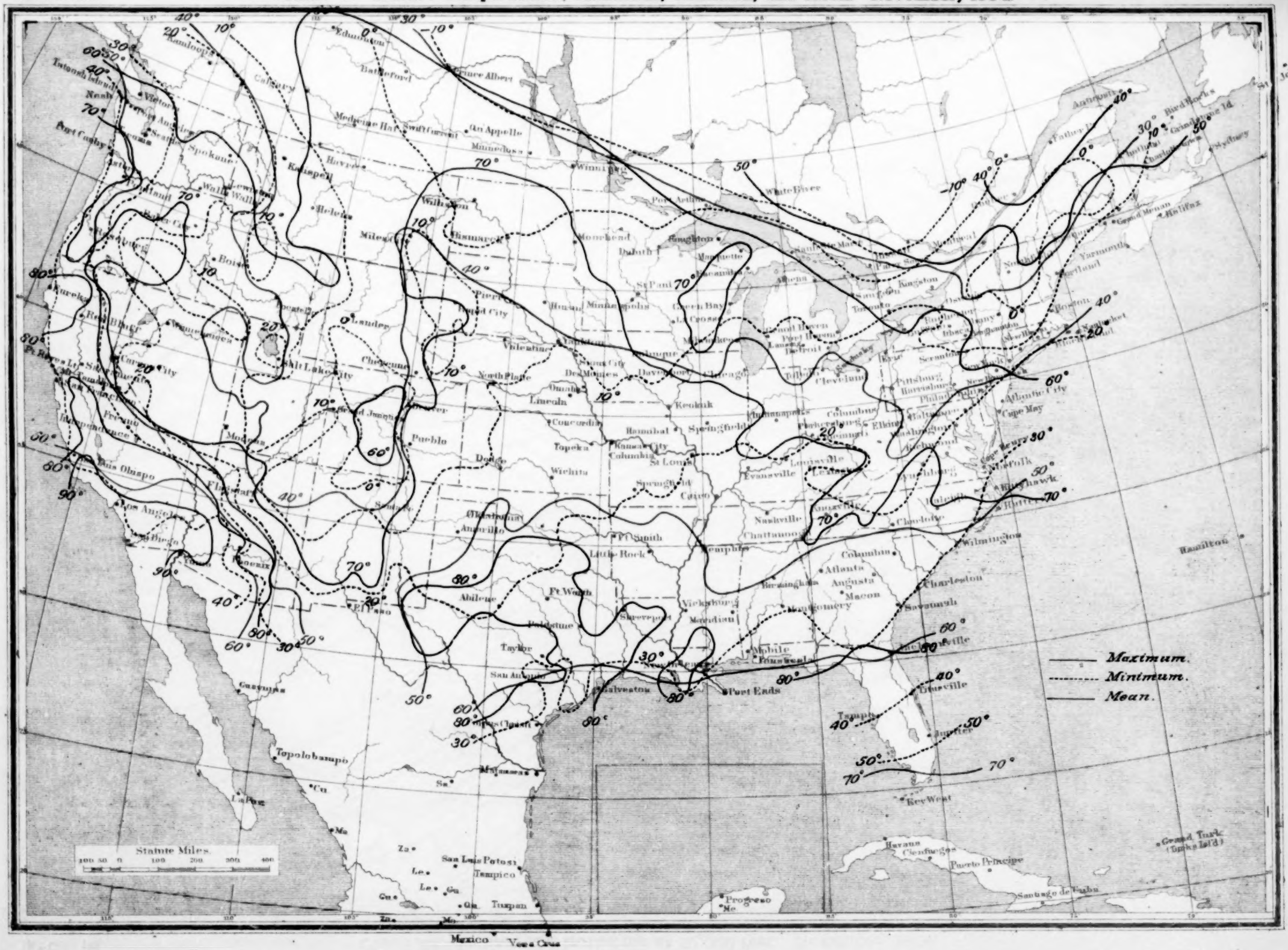


Chart V. Surface Temperatures: Maximum, Minimum, and Mean. November, 1904.

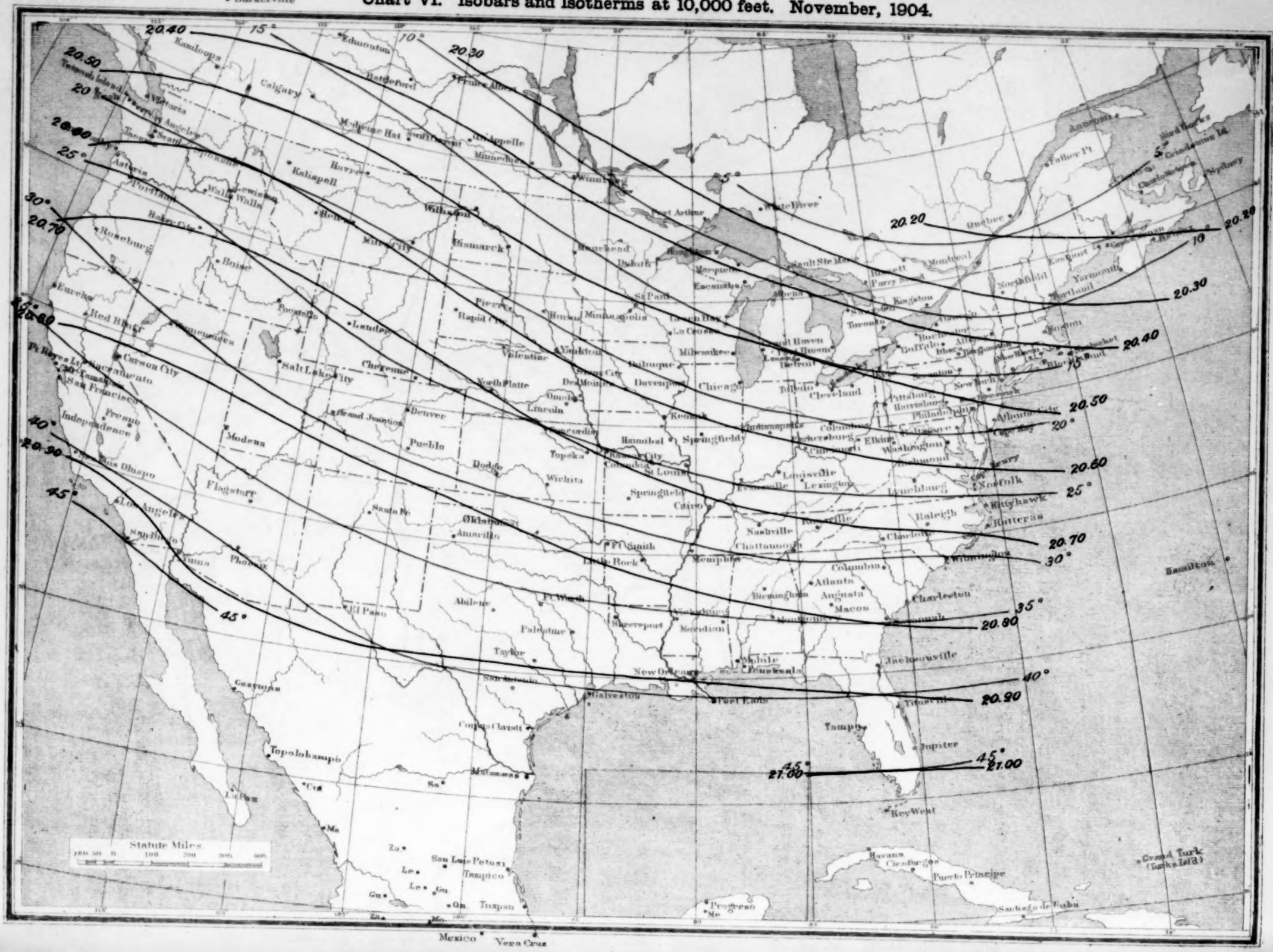
• Barkerville

Chart V. Surface Temperatures; Maximum, Minimum, and Mean. November, 1904.



• Bakerville

Chart VI. Isobars and Isotherms at 10,000 feet. November, 1904.



• Bakerville

Chart VII. Isobars and Isotherms at 3500 feet. November, 1904.

Chart VII. Isobars and Isotherms at 3500 feet. November, 1904.

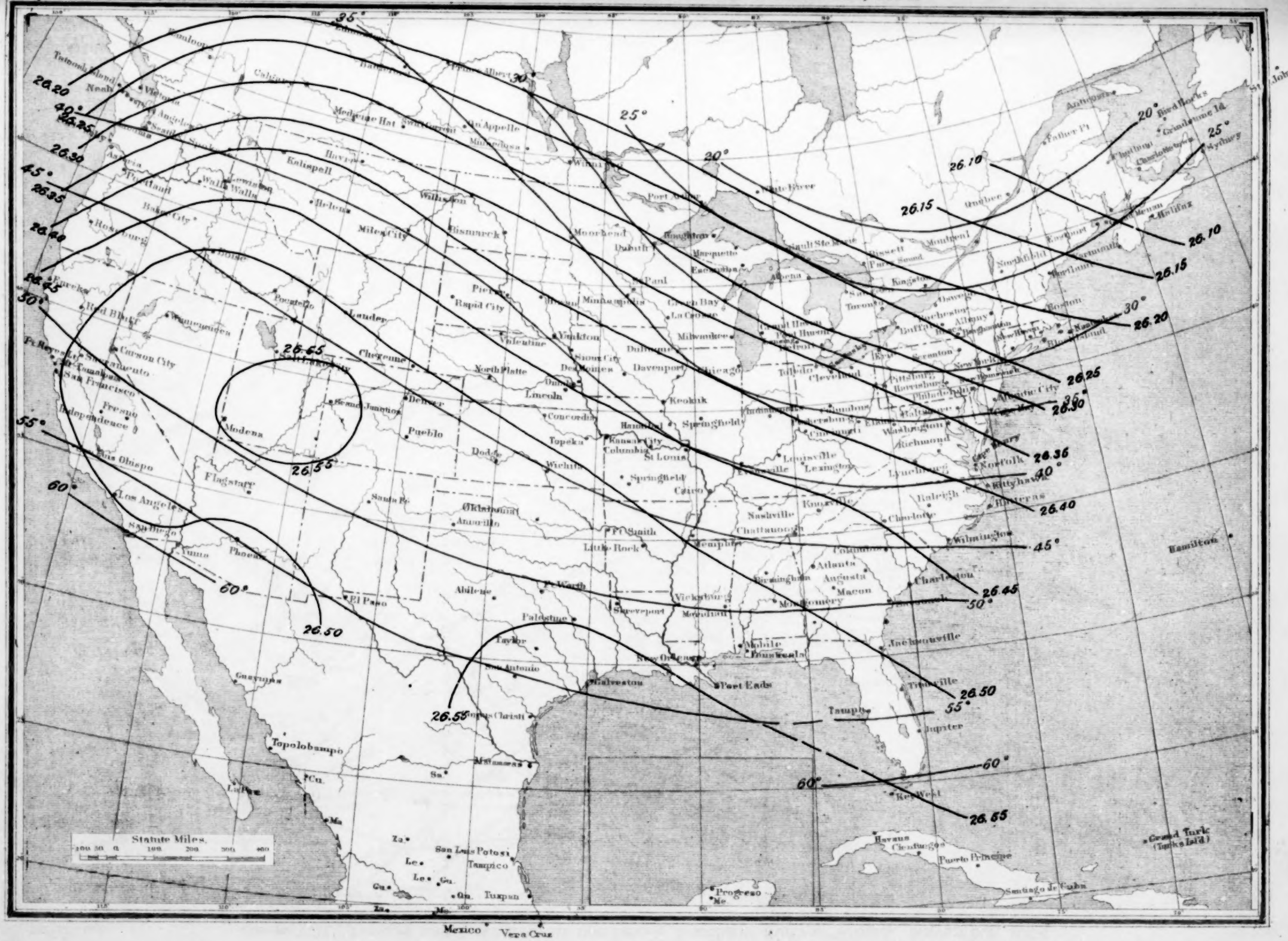


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Chart VIII. Isobars and Isotherms at Sea Level; Resultant Surface Winds. November, 1904.

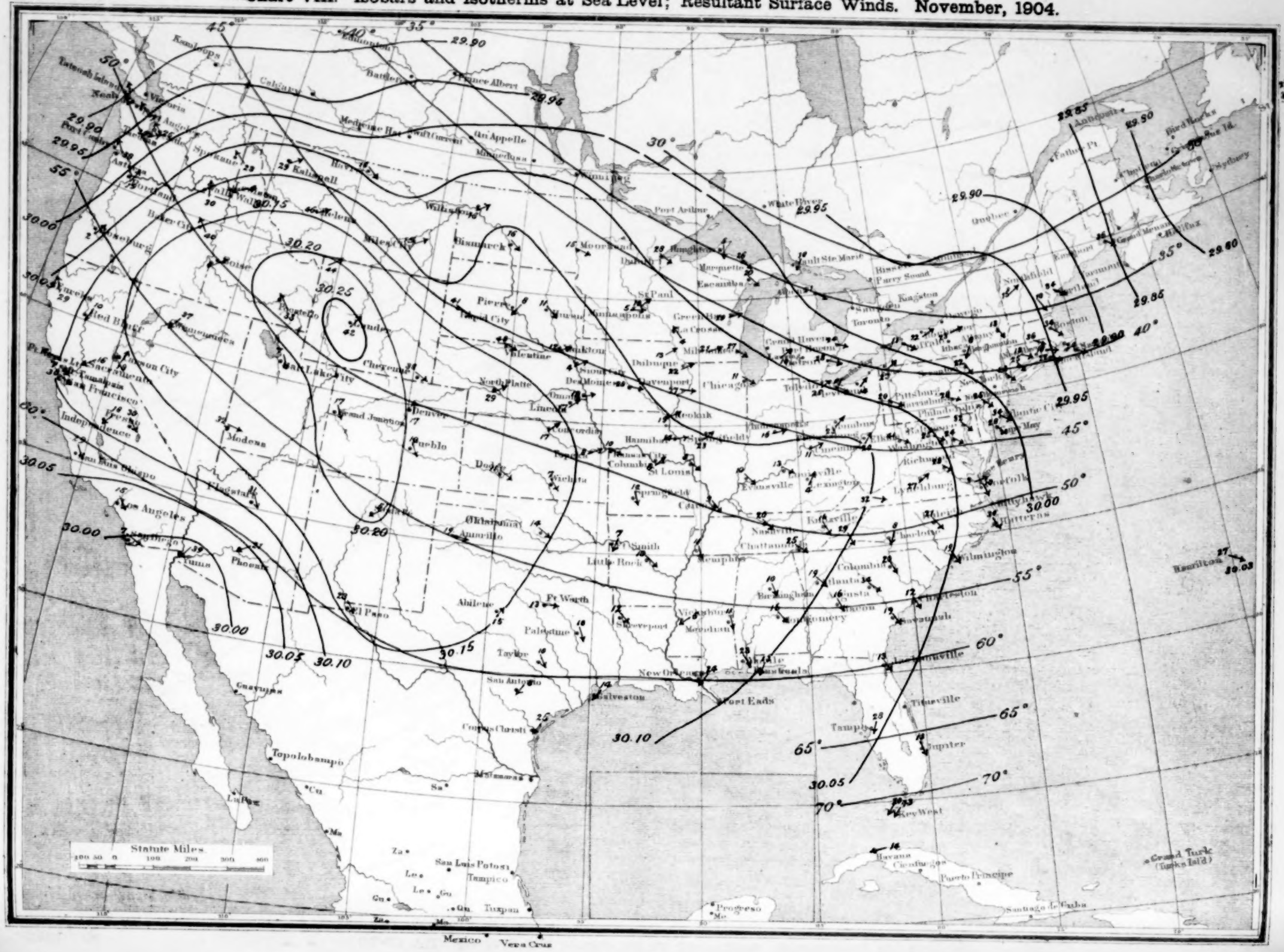

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Chart IX. Sea-Level Isobars, Surface Temperatures, and Resultant Winds. November, 1904.

Mexico Vera Cruz

Chart IX. Sea-Level Isobars, Surface Temperatures, and Resultant Winds. November, 1904.

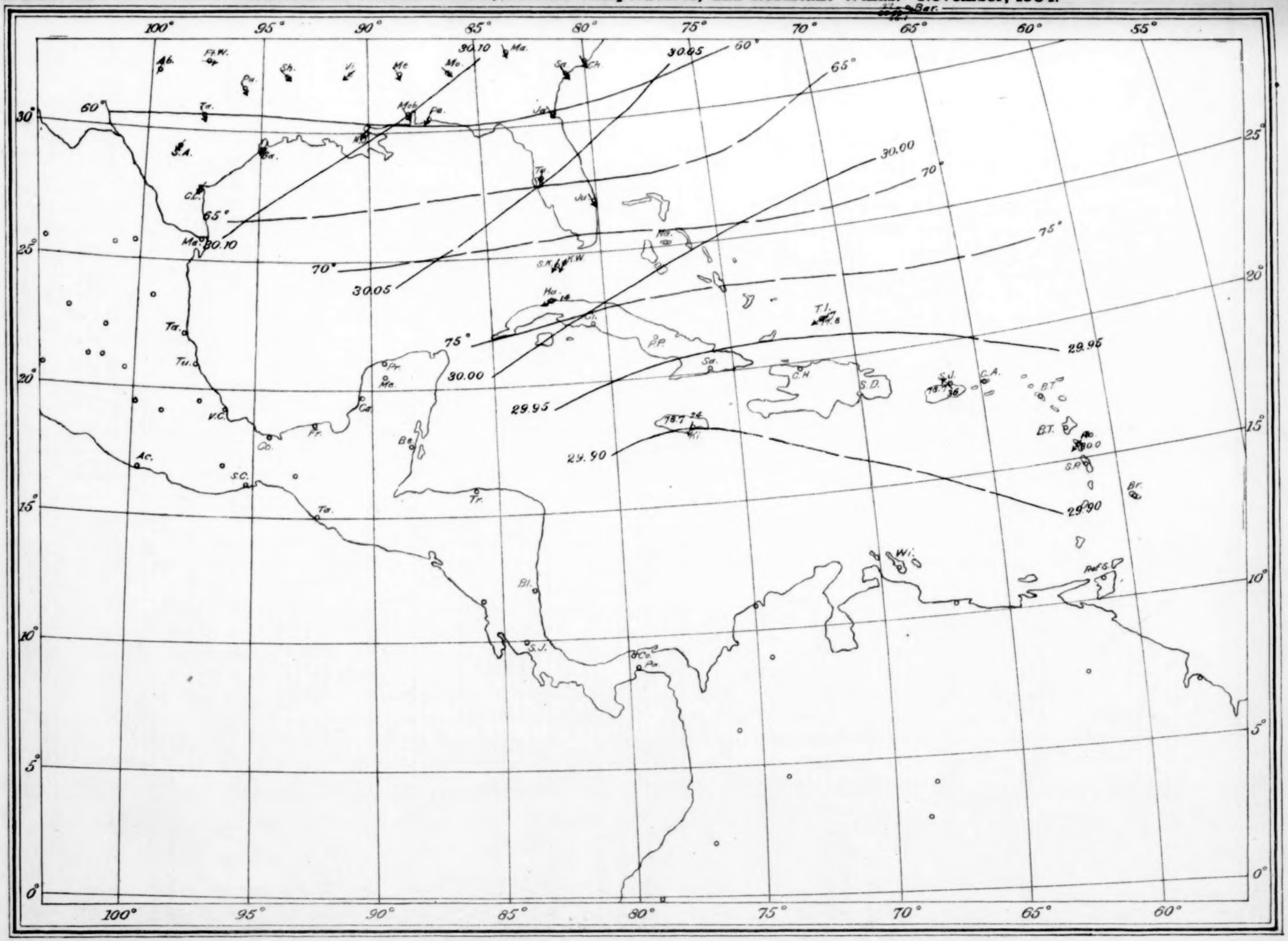

Chart X. Hydrographs for Seven Principal Rivers of the United States. November, 1904.

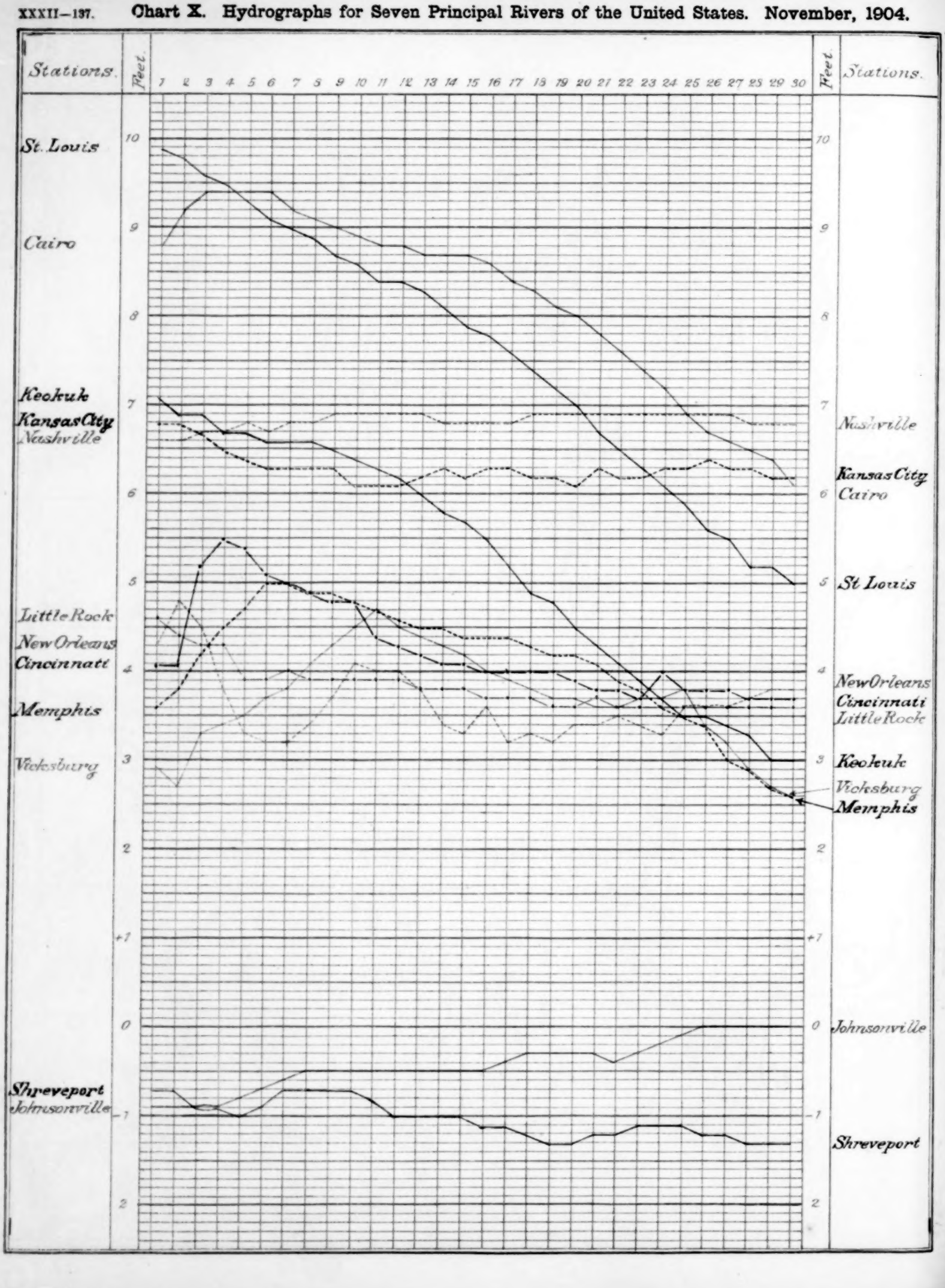
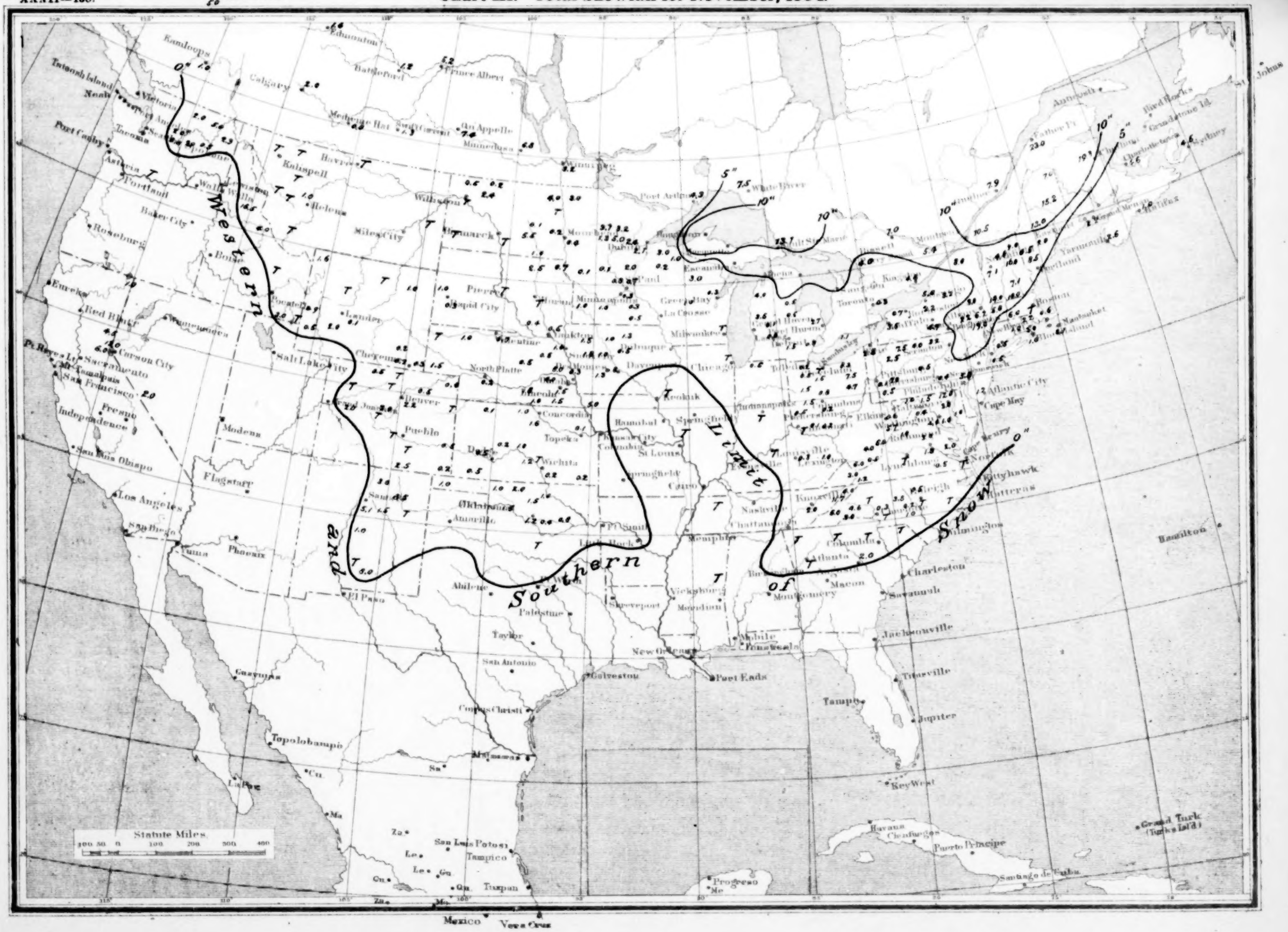
Chart XI. Total Snowfall for November, 1904.